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A PRACTICAL TREATISE ON MATERIA MEDICA AND THERAPEUTICS

BY

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ELEVENTH EDITION, REVISED AND ENLARGED

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TO THE MEMORY OF
FATHER, MOTHER, AND BROTHERS
BY THE SURVIVOR.

73924

PREFACE TO THE ELEVENTH EDITION.

IN preparing this edition I have corrected some typographical and other errors, and have added various new articles which will, I hope, improve the interest and value of the work. In this, as in all previous issues, the practical character of the work as a storehouse of facts relating to Materia Medica and Therapeutics has been preserved.

I have not been unmindful of the present tendency of pharmacological literature. An increasing disposition is discernible to develop the physiological side, to enlarge the domain of experimental work, and to interpret conditions in man by hasty and sometimes crude observations on the inferior animals. On the other hand, empirical knowledge, supported by careful clinical work, and improved by sound induction, should continue to be an important element in the structure of any therapeutical system.

I have again to thank my readers and constant friends for their approval of the successive issues of my Treatise.

R. B.

PHILADELPHIA, PA., *1903.*

PREFACE TO THE TENTH EDITION.

In sending forth the tenth edition of this work, I can do no less than thank my readers for this evidence of the esteem in which they continue to hold it. To render this edition still more worthy, I have added accounts more or less full of the newer remedies, have inserted a special article, though succinct, on prescription writing, and have made changes at various points to correct errors that have been overlooked, and to supply omissions of necessary matter. To accomplish these objects with as little increase of space as possible, I have stricken out references at various places. These are the less to be deplored as medical libraries are becoming more numerous and readily accessible, and this kind of information is sufficiently conveyed to the intelligent reader by the mention of the names of the more important contributors.

In the prefaces to the eighth and ninth editions respectively, my views regarding the admission to the work of the rapidly increasing new remedies have been sufficiently given. As the next decennial revision of the United States Pharmacopœia is near at hand (1900), we may look for some authoritative action then, whereby the present state of uncertainty may be finally terminated.

ROBERTS BARTHOLOW, M. D.

1527 LOCUST STREET, PHILADELPHIA,
July, 1899.

PREFACE TO THE NINTH EDITION.

In preparing the ninth edition it has been found necessary to enlarge the work by forty-five pages. Additions and alterations have been made at all points to dispose of the new material which the rapid development of pharmacology has contributed to the science and art of therapeutics. Much of this matter consists of accounts, more or less full, of the synthetical remedies which organic chemistry has produced and is producing in increasing numbers. For the most part these medicaments are proprietary, and are not therefore to be found in the official list of the United States Pharmacopœia. Receiving special designations often suggestive of their mode of action, they cease to be known by the technical nomenclature, and, under patent protection, are the property of the manufacturing chemist. When, by the substitution process, a remedy is evolved that seems likely to possess certain powers, it is placed in the hands of some friendly investigator to study its physiological actions, and it is then duly exploited by the manufacturer. It is undeniable that many important contributions have been thus made to practical medicine; but it is equally true that many have not sustained the pretensions of their promoters, and have either failed entirely of recognition or have only in part justified the extravagant claims made for them. The whole subject is yet hardly in a state to select out of the mass those that time and further clinical experience must justify. As in nearly every instance these remedies are derived from the aliphatic (fatty) and aromatic series of organic compounds, it is not surprising that there should be in respect to many of them considerable similarity in the mode and character of their actions. In the absence of an authoritative tribunal to decide on the remedies for recognition and use, I have employed my own judgment in selecting those for treatment in this work. Time will determine the value of those taken up for consideration: some will continue in favor; the failures will be eliminated.

I must again give expression to the gratitude I feel over the long-continued success of the work; for the disappearance of successive large editions is the best evidence of appreciation by my readers and of approval by the organs of professional opinion.

ROBERTS BARTHOLOW, M. D.

1527 LOCUST STREET, PHILADELPHIA,
August, 1896.

PREFACE TO THE EIGHTH EDITION.

THE decennial revision of the United States Pharmacopœia involves so many changes in remedies and formulæ, that a treatise on Materia Medica must of necessity be newly edited to make it conform to the only official standard. I have, accordingly, revised my work, have changed the formulæ as required by the new Pharmacopœia, and have added to the list of remedies many that have only recently appeared. In so doing I was brought face to face with the important question of admitting proprietary medicaments. The Convention for the Revision of the Pharmacopœia, at its last session in Washington, instructed the committee to whom the work of revision was intrusted to omit from the work all proprietary remedies or preparations. Those instructions were obeyed, and only those synthetical products not proprietary were given a place in the list of remedies. As a member of the Revision Committee I coincided in the propriety of this action, and I may seem inconsistent now that in my treatise I have admitted many of the remedies in question. But the functions and sphere of the two works differ. The Pharmacopœia is an official guide for pharmacists and physicians, and must therefore pursue a conservative course in admitting new remedies, and refuse its countenance to those of proprietary origin, either secret or protected by letters patent. A treatise on Materia Medica should, as a rule, be governed by the same considerations; but in the case of the new synthetical products, so important are their attributes, so largely have they come into use, and so great is the demand for true information regarding them, that a text-book would be considered wanting in thoroughness and completeness if it contained no reference to the more important of them at least. I have therefore given an account, more or less complete, of various members of the group. It is the less necessary to include all that have been proposed and used to some extent in medical practice, since not all have proved useful, and many agree so closely in their actions that one may be substituted for another in the treatment of the morbid states to which they are adapted.

As the new Pharmacopœia has employed the metric system in its weights and measures, it becomes necessary for all systematic works treating of the Materia Medica to follow its example. That my readers unacquainted with the metric system may have no difficulty, I have added in a brief appendix a tabular statement of the equivalents of weights and measures from one Troy ounce down, for which I am indebted to the Pharmacopœia.

I venture the expression of my belief that this new edition will prove still more worthy of the remarkable favor which the work has enjoyed from its first appearance.

ROBERTS BARTHOLOW, M. D.

1527 LOCUST STREET, PHILADELPHIA, *October, 1893.*

PREFACE TO THE FIRST EDITION.

To offer to the medical profession a new treatise on Materia Medica and Therapeutics may appear to be a labor of supererogation. The medical literature of this country is already well provided with able and elaborate works on this subject. The learned and encyclopedic volumes of Stillé, based on the empirical method, and the modern and scientific work of H. C. Wood, based on the physiological method, leave almost nothing to be desired. Entertaining such a profound respect for the work of my American colleagues, it may well be inquired why I have ventured to add a new book to those already existing in this department of medical knowledge. A belief, which I trust will not be regarded as egotism, that I have earned the right to address the medical profession, has moved me to the preparation of this work. Several years a teacher of Materia Medica and Therapeutics, I have necessarily formed opinions as to the kind of information which should be contained in a treatise on this subject. As far as such a course of experiment is practicable, I have demonstrated in my lectures the actions of remedies on animals. I have conducted in my private laboratory many independent investigations, and have contributed in this way, I submit with diffidence, some original knowledge to the subject of therapeutics. The information thus acquired has been supplemented by twenty-two years of clinical experience as a practitioner of medicine. Under these circumstances, I am induced to believe that my professional brethren, and medical students, will hold that I am entitled to a hearing.

A volume on Materia Medica and Therapeutics should, in these days, present some new features of importance if it would worthily occupy a place alongside of the excellent works now accessible to American readers. An examination of this treatise will disclose the fact that it differs from other works in its scheme of classification, in the subjects discussed, and in the very practical character of the information. In the present state of our knowledge, it is impossible to make a classification free from defects, and I do not claim for mine that it is superior to others—only that its simplicity is a point in its favor. As respects the subjects treated of, it will be seen that the most elaborate section is that on aliment, and that remedies have been introduced not usually referred to by therapeutical writers. In the treatment of individual agents, I have, usually, adopted the description of the "United States Pharmacopœia," and have omitted botanical and chemical details, unless they are necessary to elucidate physiological questions, or to facilitate intelligent prescription-writing. All pharmaceutical questions are most thoroughly handled in the "Dispensatory" of Wood and Bache, and this kind of knowledge is more the province of the druggist than of the physician.

In describing the physiological action of drugs, two methods may be pursued: to present in chronological order a summary of the opinions of various authorities on the subject in question; or, to condense in a connected description that view of the subject which seems to the author most consonant with all the facts. I have adopted the latter plan, from a conviction of its advantages for the student, and of its utility for the practitioner. The authorities which I have utilized in making up my opinions are placed at the end of each article, in order to avoid interruptions in the methodical descriptions.

As respects the therapeutical applications of remedies, I have, as far as practicable, based them on the physiological actions. Many empirical facts are, however, well founded in professional experience. Although convinced that the most certain acquisitions to therapeutical knowledge must come through the physiological method, I am equally clear that well-established empirical facts should not be omitted, even if they are not explicable by any of the known physiological properties of the remedies under discussion.

My best acknowledgments are due to John Chatto, Esq., the learned Librarian of the Royal College of Surgeons, London, for numerous courtesies extended to me during my visits to Lincoln's-Inn-Fields.

ROBERTS BARTHOLOW.

120 WEST SEVENTH STREET,
CINCINNATI, OHIO, *June*, 1876.

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A TREATISE

ON

MATERIA MEDICA AND THERAPEUTICS.

SCHEMA.

PART I.—*Modes in which Medicines are introduced into the Organism.*

PART II.—*The Actions and Uses of Remedial Agents.*

I. SYSTEMIC REMEDIES:

1. Those used to promote the constructive tissue metamorphosis (Tonics).

2. Those used to increase the retrograde tissue metamorphosis (Alteratives).

3. Those used to destroy micro-organisms or morbific germs, and to prevent or arrest septic processes (Antiseptics).

4. Those used to modify the functions of organs:

A. Of the Nervous System:
    Increasing Action,
    Diminishing Action.

B. Of the Gastro-Intestinal Canal:
    Emetics,
    Cathartics,
    Anthelmintics.

C. Of the Genito-Urinary Organs:
    Diuretics,
    Emmenagogues, etc.

II. TOPICAL REMEDIES:
    Rubefacients,
    Epispastics,
    Escharotics, etc.

In this scheme the medicament is followed from its introduction into the stomach to its elimination by the organs of excretion. One group of remedies is used for an action on the primary assimilation—to promote digestion and absorption—the first step in the great process of blood-making. Of this kind are pepsin, the bitters, but, above all, foods.

Some remedies are employed both to increase the activity of the primary assimilation and the utilization of materials in the construction of tissues; others, to hasten the retrograde metamorphosis, or the processes of waste and excretion. The action of iron furnishes a typical example of the one, and mercury of the other mode of influencing the function of assimilation.

An important group of remedial agents is constituted of those having the power to act on—to inhibit or destroy—pathogenic organisms, and to prevent or arrest septic processes. As these remedies are also antipyretic, there is supposed to be a relation between this attribute and the germ-destroying and antiseptic powers. As substances having the chemical reactions and toxic activity of alkaloids, and known as *ptomaines*, are produced by septic decomposition in the intestinal canal under certain conditions, and as similar agents are developed in the organism in the course of infectious diseases, remedies possessed of such powers must necessarily occupy an important place in therapeutics.

Besides the foregoing, there are several groups of remedial agents, that are used not to affect metamorphosis of tissue in any manner, but to modify the functions of organs. As the most influential and widely connected are the functions of the nervous system, the remedies affecting them are appropriately considered first. They may be conveniently grouped in two classes: those that exalt, those that depress function—as excito-motor, depresso-motor. Of these, strychnine is a type of the former, conium of the latter.

Other functions are affected by remedies in several modes: by coming in contact with the anatomical elements of organs engaged in their elimination, or being so irritant as to excite action for their expulsion. The diuretics, for the most part, illustrate the former mode of action, and some emetics and purgatives the latter. The actions cease with the expulsion or elimination of the offending matters.

Remedies that are truly topical should make a local impression only, but it is probable that no action can be confined to the part acted on. Absorption is not necessary to, and indeed hinders, the local effect; hence the systemic impression made by them is accomplished through the agency of the nervous system. Some of the most important of their therapeutical effects are due to the influence of the peripheral excitation on the nervous centers in anatomical connection with the part irritated. A superficial neuritis may excite extensive secondary lesions in the spinal cord. The vaso-motor and trophic systems are peculiarly impressionable to peripheric irritation, and hence, through the intermediation of this nervous apparatus, important changes may be wrought by slight counter-irritation.

PART I.

ROUTES BY WHICH MEDICINES ARE INTRODUCED INTO THE ORGANISM.

I.

THROUGH THE EXTERNAL INTEGUMENT.

By this tissue medicines are applied in the following modes:
Enepidermatic.
Epidermatic.
Endermatic.

Enepidermatic.—In this method, the medicament is placed in contact, only, with the epidermis, and friction, to hasten absorption, is not employed. Although the epidermis opposes a strong obstacle to absorption, it does not entirely prevent diffusion into the blood, as numerous facts show. The skin may be considered a colloidal septum. The rate and degree of absorption of any medicine will depend, in large part, on its power of diffusion. Various circumstances influence this—for example, the chemical position of the agent to be diffused. On one side of the colloidal septum—the skin—lie the blood-vessels, containing an alkaline fluid. An acid fluid on one side of the dialysing membrane, and an alkaline fluid on the other, are conditions most favorable to diffusion. Experiments are wanting on this point, but it is a reasonable presumption that solutions of medicinal substances, acid in reaction, will find their way most readily into the blood.

Besides the epidermis, the sebaceous matter of the skin offers more or less positive obstruction to cutaneous absorption. Medicinal substances in solution in water, therefore, very slowly permeate the skin to enter the vessels. Waller, who has made very careful experiments, has ascertained that alkaloids dissolved in chloroform are readily transferred through the skin into the blood, and produce characteristic phenomena, while "alcoholic and aqueous solutions are either not at all, or very slowly, absorbed."

His observations were made with chloroformic solutions of aconitine, atropine, strychnine, and morphine. Waller further ascertained that alcohol mixed with chloroform did not retard absorption, but alcohol alone caused an outward osmotic flow. It follows from these facts that, if, in the application of a medicinal agent to the skin by the enepidermatic method, the object be to promote absorption, the remedy should be dissolved in chloroform, or in a mixture of alcohol and chloroform, and not in alcohol alone, or in water.

EPIDERMATIC.—This method differs from the enepidermatic in that friction is employed to promote absorption by forcing the medicament between the cells of the epidermatic layer. Many agents are used in this way, as mercurial ointment in syphilis, cod-liver oil, and other fats, in wasting diseases, and ointments of various kinds for the relief of local lesions, etc. The evidence is conclusive that by this mode systemic effects are produced.

ENDERMATIC.—As the epidermis is the chief obstacle to cutaneous absorption, it is sometimes removed by blistering, so that the medicament may come into immediate contact with the derma. The mode of proceeding by the endermatic method is as follows: a piece of flannel, patent lint, or cotton cloth, is moistened with *aqua ammoniæ*, and when placed on the skin is covered with oiled silk to prevent evaporation. When the blister is raised, the epidermis is removed with scissors. A less painful, but slower method, is the application of a cantharides-plaster, followed by a poultice to raise the blister. The medicinal agent, in a finely-powdered state, is sprinkled over the raw surface, and is rapidly absorbed. Morphine, atropine, strychnine, and quinine, are the most important agents used in this way.

The endermatic method is a useful resource to the therapeutist, but the opinion of Brown-Séquard is hardly admissible, that the extensive use of the hypodermatic method has caused the endermatic to be unwisely neglected. There are decided objections to the endermatic method: it is painful; absorption is somewhat uncertain; ulceration of an intractable character may occur. It has these advantages in its favor: it may be used in cases of irritable stomach; it may be conjoined with counter-irritation; it is sometimes quite effective.

II.

THROUGH THE INTERNAL INTEGUMENT.

APPLICATIONS TO THE BRONCHO-PULMONARY MUCOUS MEMBRANE.—By the method of INSUFFLATION solid medicinal agents in a finely-divided state are applied to various parts of the respiratory tract. Insufflation-tubes with a rubber air-bag attached are now found at the instrument-makers. The powder, contained in a chamber intended for its reception, is forced by the compression of the air-bag through the straight or curved delivery-tube of the instrument. Powders may be projected by such an apparatus into fauces, larynx, and anterior and posterior nares. In the absence of an insufflator, a simple glass tube or goose-quill may be used for the purpose—the powder being blown in by the operator, or drawn in by a forcible inspiration by the patient.

The method of insufflation is a useful mode of making local applications to the nares, fauces, epiglottis, and the aryteno-epiglottidean folds, but it is of little utility as a means of reaching the larynx and trachea, for, as is well known, the glottis is exceedingly intolerant of foreign bodies whether solid or gaseous. By this method we can use tannin, the zinc salts, nitrate of silver, alum, morphine, etc. Any remedy thus applied should be in small quantity, should be minutely subdivided and mixed with some unirritating, impalpable powder, so as to insure uniform distribution over the surface to be acted upon.

The *nasal douche* is a mode of applying remedies to the nasal passages now much practiced. This consists of a bottle or funnel-shaped reservoir to contain the medicated fluid, and a flexible rubber tube to which is attached a hard-rubber or glass nose-piece. The reservoir being placed on a higher level than the head, the nose-piece adjusted and the mouth being kept open, the fluid is permitted to flow. As when the mouth is open, the patient breathing quietly, the palate applies itself closely to the posterior wall of the pharynx, it is obvious that the fluid will be conducted from the one to the other nostril and thus make its exit. Not every patient can succeed perfectly in the performance of this feat. In some persons, even when breathing quietly through the open mouth, the veil of the palate does not apply itself perfectly to the posterior fauces and the fluid flows into the œsophagus. Other persons can not refrain from attempts at swallowing when the fluid reaches the posterior nares. It happens not infrequently that the fluid, or the insufflation powder, gets into the Eustachian tube and middle ear, so that pain and inflammation follow with impaired hearing, and sometimes cause destructive inflammation and suppuration. If pain in the ears follows its use, it is quite certain that mischief will result if the douche be persisted in. The following rules should be adhered to in making applications by this method:

The fluid used must be tepid.

The first applications must be bland and unirritating.

The applications, if strong enough to excite irritation, must not be used frequently.

Under the most favorable circumstances this mode of treating diseases of the nasal passages has very limited utility, for the fluid reaches but a part of the Schneiderian mucous membrane. It is a useful means for cleansing the nares, and for applying deodorizing agents to correct fetor. Chlorides of sodium, potassium, and ammonium, permanganate of potassa, carbolic acid, iodine, and many other agents of the same kind, are applied by means of the nasal douche.

An ordinary Davidson's syringe, made to act as a siphon, may be used in the same way as the Weber's or Thudichum's nasal douche. The mode of proceeding with this instrument is as follows: the vessel containing the medicated fluid is placed on a higher level than the patient's head; the syringe is filled by compressing the bulb to expel the air, and then inserting the suction-pipe in the fluid; the nozzle of the delivery-pipe is put into the nose, when a steady stream will discharge into the nostril and escape by the other.

INHALATIONS.—Vapors of medicinal substances, and gases, are conducted with the air into the bronchial tubes and the air-sacs. Vapor of creosote, carbolic acid, iodine, ethyl iodide, iodoform, bromine, etc., are thus employed with excellent effect. Those that require heat to be vaporized can be put in a warm vial or bottle, and the vapor then conducted to the nose or mouth by a cone of stiff paper, the base of the cone being large enough to cover the vessel in which the vapor is forming. Of the compounds of iodine, the most convenient and effective for inhalation is ethyl iodide. It requires no special contrivance, and does not have an anæsthetic effect that will narcotize. The warmth of the hand is sufficient to vaporize it, and hence it may be inspired from the vessel containing it. A few drops (ten to thirty) may be put on a folded napkin or handkerchief and inhaled, or the same quantity can be dropped in a vial previously warmed, and immediately inhaled. Ethyl-iodide vapor can be readily mixed with a proper proportion of nitrous oxide, or combined with the vapor of iodine, iodoform, creosote, carbolic acid, and with other antiseptics. Whatever difficulties are encountered are merely mechanical. In a recent issue of the "Æsclepiad" (1886), Dr. B. W. Richardson, of London, calls attention to the remarkable powers of ozonic ether as a remedy in pulmonary diseases—a recommendation which he holds is the most valuable he has ever contributed to practical medicine. His mode of procedure is described in the article referred to, and an abstract may be found in the "New York Medical Journal" of March 13, 1887.

Pyridin vapor has been brought out by Professor Sée, as an inhalant of remarkable efficacy in asthma and other neuroses of the respiratory apparatus. The air of an apartment of suitable size can be made by diffusion to contain a proper amount of pyridin vapor. As persons vary in susceptibility to the action of such a vapor, the necessary quantity must be ascertained by trial. Various permanent gases are now used by inhalation, in diseases of the respiratory mucous tract. An improvement warmly received, yet already waning, is the rectal injection of sulph-hydric and carbonic-acid gases. Bernard having shown, experimentally, that these gases when introduced into the rectum, escaped by the lungs without penetrating to the nervous centres, Bergeon, of Lyons, utilized this fact, and in this way proposed to act on the bacilli of tuberculosis of the lungs. The method was received with extraordinary favor, and in a few weeks was employed in all parts of the world. It was presently ascertained, however, that the bacilli were not destroyed, and the benefits derived did not compensate for the disagreeable incidents of the injections.

The suggestion of Dupont that the inhalation of the carbonic-acid gas should take the place of the rectal injection of the gases, and the growing belief in the superiority of inhalations, have quite occupied the field, and hence the rectal injections are no longer practiced. Prolonged inhalation of volatile materials is a mode rapidly growing in favor, and is supplanting douches, insufflation, and other kinds of topical applications. As air is a natural vehicle for access to the lungs, and as gases and volatile substances can pass into the air-sacs by means of it, the method of introducing medicaments by respiration is naturally superior to the various mechanical contrivances. Volatile medicines capable of diffusion through the air, and gases, may be thus used with success. The most powerful of these preparations is the liquid of the French chemist, *Pictet*. The sulphurous and carbonic-acid gases are liquefied by pressure and stored up in siphon bottles, from which they are readily obtained by a mere touch on the valve. It is obvious that such an arrangement is highly convenient, but the power for mischief must not be overlooked in estimating the curative value.

Atomization or Pulverization.—Air or steam is the motive power in the various forms of apparatus used for reducing solutions of medicinal agents into spray. Of those now in use, the hand-ball apparatus for air, and Siegel's apparatus for steam, are the principal. Whether air or steam be used for pulverizing the medicated fluid, the essential parts of an atomizing apparatus consist of a cup for containing the solution to be pulverized, a vertical tube terminating in a fine capillary extremity and dipping into the medicine-cup, and a tube communicating with the steam-boiler or air-bulb, and placed at right angles to the vertical tube. When air or steam is forced through the horizontal tube, over the capillary orifice of the vertical tube, the air in the latter is rarefied and the fluid rises into it, until, reaching the top of the tube, it is broken up into fine spray by the impact of the horizontal column of air. It is obvious that, provided with suitable tubes, spray may be applied to the nares, anterior and posterior, to the pharynx, epiglottis, and larynx. The utility of applications made in this way to these parts is now conclusively established. Although it has been a question whether any quantity of medicated spray passes the chink of the glottis, it has been proved experimentally that a minute quantity does actually enter the trachea. The efficacy of inhalations of subsulphate of iron in pulmonary hæmorrhage is a clinical fact confirmatory of the experimental demonstrations. The inhalations of substances in a state of vapor, and atomized, in affections of the parts beyond the larynx, have thus far been rather disappointing, except, it may be, the treatment of pulmonary hæmorrhage by iron inhalations.

In using these topical remedies, some precautions must be taken to avoid harm. Strong applications should not be made in the beginning of the treatment. The mucous membranes should be accustomed to the impact of such unirritating substances as warm water and tepid solutions of common salt and chloride of ammonium, before commencing the use of tannin, the zinc, copper, and silver salts, etc. For cleansing the mucous membrane and removing fetor, common salt, carbolic acid, iodine, and the sulphides are useful, and as astringents and deodorizers, the sulpho-carbolates of zinc, soda, tannin, etc. One of the more effective applications for the cure of diseased states is nitrate of silver, but it should be kept in mind, in using this agent, that the handkerchiefs and linen of the patient will be soiled. Solutions of nitrate of silver are best applied by means of the hand-ball atomizer, tubes of various shapes, according to the locality, being inserted into the anterior and posterior nares, pharynx, or glottis, as the case may be. Should the steam atomizer be used for making application of the various salts named above, the face of the patient should be protected by a shield.

As iodoform is so offensive because of its diffusive and persistent odor, it is now being supplanted by *iodol*, which is odorless, and at the same time, containing as it does as much iodine nearly, has proved to be quite as effective. In using the method of insufflation with iodol, combinations of the same agents can be made with it as with iodoform. Dr. J. Solis-Cohen, a laryngologist of great eminence, maintains that the combinations of these iodine preparations with tannin are more efficient in the treatment of the various morbid states than any other. The nature of the curative action, in large part, consists in the detention of the iodol or iodoform on the seat of disease, for the tannic acid combines with the mucus, and thus holds the medicament in contact with the affected surface.

APPLICATION TO THE GASTRO-INTESTINAL MUCOUS MEMBRANE.—The stomach is the organ most usually selected for procuring absorption of remedial agents. Diffusion through the walls of the stomach into the blood is by no means definite in rate, or in the quantity passed even with the same medicament and in the same individual. The presence of fluid or food, the chemical reactions which may ensue, the state of the mucous membrane, the blood-pressure in the veins, and the condition of annexed organs, are circumstances modifying the rate and degree of absorption. The stomach empty, the mucous membrane in a healthy state, veins not turgid, are the conditions most favorable for rapid and perfect absorption. Crystalloidal substances in solution, which pass by simple osmosis into the vessels, are taken up more rapidly and perfectly than colloidal substances which require preliminary digestion and solution. It follows, therefore, that medicines in solutions not intended for a merely local action on the stomach mucous membrane, and not irritant in character, as salines, alkaloids, etc., should be administered when the stomach is empty. Substances that are irritant, or that require digestion and solution, or that, like iron, are intended to supply a material to the blood in which it is deficient, are best administered during the process of digestion. On the other hand, many of the metallic salts precipitate pepsin and thus derange digestion, whence it follows that they should not be given after food, if unimpaired digestion be essential to the safety of the patient.

Although it is true that medicines in solution are more readily taken up than solids, yet many of the latter are absorbed with great facility, as metallic iron, calomel, etc., which are rendered soluble by the gastric fluids. The chemical changes induced in medicines by the gastric juice are by no means well understood. How individual agents are affected is a subject to be considered hereafter.

The following are the chief forms in which medicines are administered by the stomach :

Powders are medicines reduced by mechanical subdivision, or by precipitation, to various degrees of fineness. The Pharmacopœia of U. S. advises several grades ; a *very fine* powder is one triturated to that degree that it should pass through a sieve having eighty or more meshes to the linear inch ; a *fine* powder is one which should pass through a sieve having sixty meshes to the linear inch ; a *moderately fine* powder is one which should pass through fifty meshes ; a *moderately coarse* powder through one having forty meshes, and a *coarse* powder through one having twenty meshes to the linear inch. These powders are designated respectively No. 80, No. 60, No. 50, No. 40 and No. 20. Those soluble in water are usually administered in that menstruum. If insoluble, they may be suspended in water by means of sugar, sirup, solution of gum, glycerin, or they may be rubbed up with some innocuous powder, as sugar, sugar of milk, liquorice-powder, etc.

Triturationes are made by triturating 10 grm. of the drug with 90 grm. of sugar of milk.

Pills are small masses of medicine made into a globular shape, by means of an extract, conserve of roses, sirup, or glycerin. A pill should not exceed five grains in weight, including the excipient, and, as a rule, it should be smaller than this. To cover the taste, pills may be coated with sugar, gum, gelatin, silver or gold foil. It should not be overlooked that pills too long kept, especially when sugar-coated, become very hard and insoluble, and therefore without activity. Extemporaneously, pills may be covered with fine tissue-paper, or enveloped in a raisin, to cover the taste of the ingredients.

A Mixture is a suspension of one or more insoluble substances in the vehicle, by means of sugar, gum, glycerin, treacle, albumen, etc. The term *emulsion* is restricted in application to the mixture of oil and water, in which the oily particles are suspended mechanically by rubbing them up with water and gum.

Extracts are solid and fluid. The solid extract may be aqueous or alcoholic; in the one case water, in the other alcohol, being the menstruum employed to extract the active and soluble principles. An extract is *solid* when evaporation is carried far enough to produce a soft paste or a dry mass; it is *fluid* when sufficient alcohol and water are retained to give the proper fluidity. The strength of the fluid extract (Pharmacopœia, 1890) is as follows: One thousand grm. of the medicament, and to this alcohol, or alcohol and glycerin, or alcohol and water, added in sufficient quantity to make 1,000 c. c. The powder (usually No. 60) is packed in a cylindrical percolator, and a portion of the menstruum is poured over it. It is then allowed to macerate for forty-eight hours, usually, after which percolation is allowed to proceed, the menstruum being added gradually. The strength of such a fluid extract is in the proportion of minim to grain.

Abstracta, which were recognized for the first time in the Pharmacopœia of 1880, were removed from the list of 1890.

Infusions are such solutions of active and soluble principles as can be extracted by digesting the crude drug in water, cold or at a temperature short of boiling. When water at the boiling temperature is used, the resulting solution is termed a *decoction*. Cold infusions are, when practicable, to be preferred to decoctions, for, at the temperature of boiling water, many active principles are decomposed or volatilized.

Infusa are prepared by taking 50 grm. of the drug coarsely comminuted, and 1,000 c. c. of boiling water, which is poured on, allowed to stand for two hours in a suitable covered vessel, and is then strained, and sufficient cold water is added to make 1,000 c. c.

Decocta are prepared of the same strength as infusions—50 grm. to 1,000 c. c.—but the medicament, coarsely powdered, is put into 1,000 c. c. of cold water and boiled for fifteen minutes. It is then allowed to cool to 104° Fahr., when sufficient cold water is added to make 1,000 c. c.

Aceta consist of 100 grm. of drug to 1,000 c. c. of diluted acetic acid. Acidum aceticum dilutum consists of 100 grm. of acid and 500 grm. of distilled water, and therefore contains six per cent of absolute acetic acid.

Vina are preparations made with vinum album, but differ in strength. "When white wine is prescribed without further specification, it is recommended that a dry white wine of domestic production be employed." U. S. Pharm. of 1890.

Capsules are hollow cylinders or cones of gelatin, to contain offensively-tasting substances, as copaiba, oil of sandal-wood, etc. In the stomach the gelatin is dissolved and the medicament liberated.

Lozenges or Troches, button-shaped masses, are sometimes introduced into the stomach, but usually these bodies are intended to be dissolved slowly in the mouth, to exert a local action on the fauces.

Wafers are circular disks with a central cavity for holding the medicine. They are made of isinglass or of gelatin.

A Suppository is a conical mass of cacao-butter, or wax and cacao-butter, with which is incorporated a medicament, and should not weigh more than fifteen grains. They are applied to the rectum, vagina, urethra, nares, ear, and other parts.

Clyster, Enema, Lavement, are medicated solutions to be thrown into the rectum.

Although the rectum as an absorbing surface is inferior to the stomach, medicines are frequently introduced by this organ with great advantage. Some medicines enter the blood more quickly by the rectum than by the stomach, but, as a general rule, absorption is slower by the former organ. If the mucous membrane of the rectum be irritable, or if the substances introduced be irritating or bulky, they will not be retained. As the contents of the rectum are alkaline, solids requiring an acid for their solution will be slowly or not at all taken up. Acid solutions of medicinal agents, on the other hand, are readily enough absorbed, provided the quantity of acid present be sufficient to maintain solution. As a general rule the mineral salts act chiefly locally on the mucous membrane of the rectum, and enter the blood in small quantity. The salts of the alkaloids, on the other hand, are absorbed with facility. Alkaloids insoluble unless in the presence of an acid are not absorbed with the same rapidity and completeness by the rectum as by the stomach, unless they are administered in acid solution. The salts of morphine, atropine, and strychnine, in solution, are absorbed as quickly, and the last named more quickly, by the rectum than by the stomach.

Remedies administered by the rectum may be in solution suspended in some menstruum, or incorporated with a soap or fat in the form of suppository. The solution used should have the temperature of the rectum (about 100° Fahr.). The quantity administered should not exceed two fluid-ounces of solution. Before introducing a medicated solution or clyster into the rectum, this organ should be emptied of fecal matter by an ordinary enema.

Administration of remedies by the rectum is an important resource to the therapeutist in cases of inability to swallow, irritable stomach, and in children's maladies. Unfortunately, this organ soon becomes intolerant, the mucous membrane irritable, and the medicament is either at once rejected or absorption delayed.

Enteroclysis is the name given to a procedure for irrigation of the bowel, lately proposed by Cantani. It was employed during the late epidemic of cholera (1892), but is a method applicable to various disorders, and hence should be mentioned here. The fountain syringe, with its flexible tube, and a rectal tube which can be attached, is the simple apparatus employed. The solution which Cantani proposed for the treatment of cholera is as follows: Tannic acid, 5 to 20 grm.; laudanum, 20 to 30 drops; gum arabic, 30 to 50 grm.; infusion of chamomile, 2 litres (= 2 quarts). The solution of tannin is supposed to inhibit the bacillus, to precipitate the albumen, and to act mechanically by washing out the intestinal contents. The mode of performing enteroclysis is as follows: The patient lies on his back, with the knees drawn up, or on the right side, the thighs flexed on the pelvis and the body inclined forward, resting on the chest. The rectal tube is inserted up to or is passed beyond the sigmoid flexure, and the reservoir is placed at such an elevation that the pressure is sufficient to carry the fluid to the ileo-cæcal valve and beyond. Massage of the abdomen is practiced, to help the dispersion of the fluid through the small intestine from the large, and with this object in view is so conducted as to aid gravity and the hydrostatic pressure in filling the small intestine. Do fluids inserted in this way pass the ileo-cæcal valve? The evidence is contradictory. In experiments on the cadaver it was shown several years ago that, in many subjects at least, the bowel gave way to the pressure before the orifice yielded. In some instances the valve was found permeable, but this was explained by the supposition that a pathological state of the bowel had occurred, or some peculiarity of formation had existed. In the present epidemic of cholera some cases have been reported in which, subsequent to enteroclysis, vomiting of the tannin solution had occurred, whence it follows that the fluid did pass the ileo-cæcal valve. Salt solution—1 to 5 per cent—suitably sterilized, is used by the method of enteroclysis in various cases, both for irrigation of the bowel and for the systemic effects. It has been found that salt solution used in this way will have an action somewhat slower, but similar in kind to the subcutaneous infusion of salines, and hence has been employed with success after hæmorrhage or wasting discharges, or in the condition of collapse from any cause.

The same expedient can be advantageously used in the treatment of chronic diarrhœa and dysentery, in hæmorrhages, etc. It has also been employed in the treatment of certain hepatic diseases. For tannin may be substituted nitrate of silver, corrosive chloride, bismuth, and other remedies.

When should Medicines be administered?—The curative effects of remedies may be retarded, changed in form, or prevented, by untimely administration.

Remedies that are intended to act on the mucous membrane of the stomach only should be given when the organ is empty. If distant parts are to be affected in the most prompt and efficient manner, and the remedy is free from any distinctly irritating quality, it should also be taken on an empty stomach. As, when digestion is going on, the contents of the stomach are acid in reaction, if alkalies are administered, combinations take place, and salts are formed. Various organic substances are decomposed and, it often happens, rendered inert by the action of the stomach acid. If alkalies are introduced before digestion begins, diffusion of the acid-forming constituents of the blood no doubt takes place, and in this way the acidity of the gastric juice is promoted. The law of diffusion just given is equally applicable to acids; given before meals, they increase the diffusion of alkaline constituents of the blood toward the stomach.

The mineral acids, especially hydrochloric and phosphoric, increase the activity of pepsin when administered during the process of digestion, and alkalies given before digestion begins have the same effect to some extent, but, if taken during this process, retard or suspend it. Alcohol in considerable quantity lessens the activity of pepsin, but a small amount increases it. Five *per cent.* is probably the limit, and the larger the quantity beyond that the greater the injury to digestion (Klikowiz). The germicides or antiseptics interfere with the process of digestion in proportion to their power; hence the bichloride, the biniodide, and permanganates are the most injurious to pepsin. It follows that such agents should be given when the stomach is nearly or quite empty, free dilution serving to prevent injury to the mucous membrane. The sulphates, especially of the metals, nitrates, chlorates, bromides, salicylates, in the order named, decidedly lessen the ferment power of pepsin, and consequently retard digestion. None of these should be given during the period of digestion, but as long before or after as the circumstances will permit.

Remedial agents intended to enter the blood with the food must needs be given during the time when the conversion of foods is going on. Iron, the hypophosphites and phosphates, and certain lime-salts are of this character, but these remedies should be selected with reference to their action on the digestive fluids. Thus, according to the observations of Eccles, the hypophosphite of potassium, phosphate of iron, lactophosphate of calcium, citrate of iron, are among those exerting comparatively little effect on the process of digestion, while others, heretofore supposed to be free from injurious action, are especially hurtful. While the stomach contents are decidedly acid, those of the small intestine are alkaline, and sufficiently so to neutralize the stomach acid, and to maintain the alkalinity of the intestinal juices. When, therefore, it is required to have the medicament act on the small intestine, the best time to secure that object is when the flow of materials is in that direction, and, other things being equal, by combination with alkalies if the nature of the substance will permit.

Medicines intended to affect the hepatic and pancreatic secretions need to have ample time, and should be so administered as to begin their action when the periods of physiological activity arrive.

APPLICATIONS TO THE GENITO-URINARY MUCOUS MEMBRANE.—Brown-Séquard has proposed to utilize the bladder for securing absorption of remedial agents in cases of great intestinal disorder, as in cholera. Experiment has shown that morphine, for example, is taken up with considerable rapidity by this viscus.

Topical applications to the urethra and vagina are very frequently made, usually in the form of astringent injections. Suppositories, variously medicated, are also occasionally used in the treatment of affections of these parts.

III.

BY THE SUBCUTANEOUS AREOLAR TISSUE—THE HYPODERMATIC OR HYPODERMIC METHOD.

The term *hypodermic* is used in conformity with the nomenclature already existing—as "epidermic," "endermic," etc.—but the termination of the word is now altered in deference to the opinions of the best philologists. The term *hypodermic*, which has been universally adopted, is known to be formed on wrong principles, and hence, in accordance with the rules of construction, the word *hypodermatic* is substituted. As the term indicates, by this method the medicine is applied to the subcutaneous areolar tissue. This does not include the method of "inoculation," introduced by Lafargue, nor that proposed by Luton and Bertin, which consists in the injection of irritants into diseased tissues. It is obvious that by the hypodermatic method medicines can be introduced only in the state of solution. To introduce the solution under the skin, a special instrument is necessary. This is the now well-known hypodermatic syringe—a small syringe having a capacity not to exceed a drachm—the nozzle being a hollow needle having a lancet-shaped extremity for easily transfixing the skin. These instruments are various in form and construction, and are made of gold, silver, glass, or hard rubber. The most efficient instrument for ordinary use is the silver hypodermatic syringe described by the author. The piston-rod of this instrument should be semi-cylindrical, and should be graduated for minims on its flat side, to indicate the quantity of solution contained in the barrel. To avoid the ill results which may follow the use of instruments not properly constructed, they are now so made as to be easily rendered aseptic. With an asbestos packing of the piston, and needles that can be sterilized by heat, the danger of local inflammation from the deposit of septic germs is reduced to the minimum. In the instrument devised by Koch, the piston-rod with its packing is dispensed with, and the air for forcing the fluid out is furnished by a rubber air-bag which is attached to the barrel of the instrument. Allen and Hanbury, of London, have lately brought forward an aseptic instrument in which the piston-rod is made to fit accurately the barrel of the instrument, and thus any kind of packing is dispensed with. Numerous models of the hypodermic instrument have been brought forward within the past few years, from which a suitable selection can always be made. Before using any instrument it should be well washed out with boiling water, and, after using, the needle should be dried and the wire inserted. In doubtful cases, the skin at the point where the injection is to be made should be washed well with soap and water, and then bathed in hydrogen-peroxide solution, or some other antiseptic.

A medicine employed for hypodermatic use should be capable of perfect solution in the menstruum, which is usually distilled or pure water. Particles of medicine undissolved are not only not in a condition for ready absorption, but are irritant to the tissues, producing inflammation and abscess. The solution for hypodermatic use should be free from foreign matter of every description and should be neutral in reaction, or, at least, without decided acid or alkaline property. Any substance which will coagulate the blood or produce violent local irritation is unfit for hypodermatic use. A solution of even a neutral substance should not be too concentrated. Clean water, free from visible impurities, is entirely harmless, and the quantity of fluid injected is, within certain limits, a matter of indifference, provided suitable care be used in selecting the site and injecting. On the other hand, concentrated solutions are more apt to produce local irritation than dilute solutions. Moreover, a drop too much of a concentrated solution of a powerful alkaloid may produce an alarming, if not dangerous state. In ordinary syringes a few drops remain at the bottom of the barrel and in the needle—whence it follows, in using strong solutions, it is difficult to inject the precise amount desired.

Solutions of alkaloids, too long kept, become unfit for use hypodermatically, by reason of the development in them of a *penicillium*, a minute organism which grows at the expense of the alkaloid. Fresh solutions should be made when needed. When hypodermatic injections are used infrequently, it is preferable to prepare an extempore solution, using powders of a definite strength. Filtered river, melted ice, or rain water, may be used for dissolving the powders. Solutions prepared extemporaneously from ordinary spring or rain water are found to produce less inflammation, and are less likely to be followed by abscess, than solutions prepared with pure distilled water which have been kept for several days. The author, therefore, advises the use of extemporaneous solutions made with powders of suitable strength or the compressed tablets now prepared by the manufacturing pharmacists.

In practicing the hypodermatic injection it is important to avoid puncturing a vein. Serious depression of the powers of life and sudden and profound narcotism have been produced by injecting a solution of morphine directly into a vein. Fatal collapse may ensue from injecting air into a vein along with the narcotic solution. Bony prominences ought to be avoided, and also inflamed parts. It is not necessary to follow Wood, the discoverer of the hypodermatic method, who advised that the solution be inserted at those points where pain can be awakened by pressure (the painful points of Valleix). Some exceptions to this rule undoubtedly exist. The arms, the abdomen, the thighs, the calves of the legs, and the back, are suitable places. Eulenburg makes the assertion that the effect is slower when the injection is made in the back, but I have not observed this difference.

SOLUTIONS.—When the quantity of the medicament to be used hypodermatically is sufficient in bulk, the most convenient mode of procedure is to prepare extemporaneous solutions from powders or compressed tablets of definite weight. Experience has abundantly proved that clean river, cistern, spring, or well water, is better than distilled water for preparing solutions. If not very recently distilled, the water soon becomes turbid from the development in it of a minute vegetable organism—a *penicillium*—which grows at the expense of the alkaloid, and thus as it increases in impurity also lessens in strength. The antiseptics—such as carbolic acid, chloroform, salicylic acid, cherry laurel, etc.—do not succeed in preventing the development of the parasite for any considerable period unless added to the solution in such quantity as to render it very irritating. The least objectionable, and at the same time the most effective comparatively, is *chloroform-water* (*aqua chloroformi*), which is made by saturating freshly-distilled water with chloroform, about two minims being required for the ounce. Oil of vaseline is also an efficient solvent for many active principles, and is free from irritating qualities. Heating the water to the boiling point is also a highly useful expedient, for this temperature is sufficient to kill the organism referred to, and to render innocuous any organic matter present.

"Hypodermic tablets," as they are designated, are now made by the manufacturing pharmacists on an extensive scale. They have the advantage of permanence of form, solubility, and accuracy of dose. When very minute doses are required, a vehicle becomes necessary. Some manufacturers use beet-root sugar for the purpose; others, sulphate of soda; but the latter is the more commendable because it is soluble, and undergoes no change. Sugar, although soluble, has the serious disadvantage that it is liable to decomposition, and thus to produce local troubles.

FORMULÆ.

MORPHINA—*Morphine.* ℞ Morphinæ sulphat., gr. xvj; aquæ, vel aquæ chloroformi, ℥j. M. Sig.: Two (2) minims are equal to one-fifteenth of a grain.

An antiseptic solution of morphine, intended to be kept for several weeks, may be prepared according to the following formula:

℞ Morphinæ sulph., gr. xvj; acid. carbolic., gtt. v; aquæ, ℥j. M. Sig.: Two minims contain $\frac{1}{15}$ of a grain of sulphate of morphine.

Solutions of morphine may be readily prepared extemporaneously from powders or pellets of a definite strength, as follows:

℞ Morphinæ sulphat., ℈j; atropinæ sulphat., gr. ss. M. ft. pulv. no. cxx (120). Sig.: Each powder contains $\frac{1}{6}$ of a grain of morphine and $\frac{1}{240}$ grain of atropine.

ATROPINA—*Atropine.* ℞ Atropinæ sulphat., gr. ij; aquæ, ℥j. M. Sig.: One minim contains $\frac{1}{240}$ of a grain. Three (3) minims contain $\frac{1}{80}$ of a grain, which is a maximum dose for many persons.

MORPHINA AND ATROPINA.—℞ Morphinæ sulphat., gr. xvj; atropinæ sulphat., gr. ss.; aquæ, vel aquæ chloroformi, ℥j. M. Sig.: Six (6) minims contain $\frac{1}{5}$ grain of morphine and $\frac{1}{160}$ grain of atropine.

COCAINA—*Cocaine.* ℞ Cocainæ hydrochlor., gr. xxiv; aquæ, vel aquæ chloroformi, ℥j. M. Sig.: One grain to 20 minims.

URETHAN.—℞ Urethan, ʒj; aquæ, ℥j. M. Sig.: Each drachm contains 7½ grains.

DUBOISINA—*Duboisine.* ℞ Duboisinæ sulphat., gr. j; aquæ, ℥j. M. Sig.: Four (4) minims contain $\frac{1}{120}$ of a grain. Eight minims is the usual maximum dose for an adult.

HYOSCYAMINA—*Hyoscyamine.* ℞ Hyoscyaminæ sulph. vel hydrobromat., gr. j; aquæ ℥j. M. Sig.: Five (5) minims contain $\frac{1}{96}$ grain.

Hyoscine, the other alkaloid of hyoscyamus, is the better hypnotic. The following solution may be used:

℞ Hyoscinæ hydrobromat., gr. j; aquæ destil., ℥ss. M. Four minims contain $\frac{1}{60}$ grain.

STRYCHNINA—*Strychnine.* ℞ Strychninæ sulphat., gr. j; aquæ, ℥j. M. Sig.: Ten (10) minims contain $\frac{1}{48}$ of a grain.

CONINA—*Conine.* ℞ Coninæ hydrobromat., gr. j; aquæ, ℥j. M. Sig.: Ten (10) minims contain $\frac{1}{48}$ of a grain.

CURARA—or *Woorara.* ℞ Curaræ, gr. j; acid. acetic., ♏v; aquæ, *ad* ♏c (to 100 minims). M. Filter. Sig.: Ten (10) minims contain $\frac{1}{10}$ of a grain.

As the active constituents of curara are soluble in water, an aqueous solution will contain them—the residue being woody fiber, starch-granules, etc. As, however, the specimens vary greatly in strength, the character of any new specimen should be ascertained by trial on animals before giving it to man.

Any salt of the alkaloid, *curarine*, will, however, be more exact in its effects.

℞ Curarinæ sulphat., gr. j; aquæ, ℥ ss. M. Sig.: Four (4) minims contain $\frac{1}{60}$ of a grain.

NICOTIANA—*Nicotine*. ℞ Nicotianæ hydrobromat., ♏ j; aquæ, ʒ iv. M. Sig.: Four (4) minims contain $\frac{1}{60}$ of a grain.

LOBELINA—*Lobeline*. ℞ Lobelinæ hydrobromat., gr. j; aquæ, ʒ ij. M. Sig.: Four minims contain $\frac{1}{30}$ grain.

ACIDUM HYDROCYANICUM DILUTUM.—℞ Acid. hydrocyanic. dil., q. s. Sig.: Four minims is the maximum single dose.

ESERINA—*Eserine*. The extract of Calabar-bean dissolved in sufficient water, and filtered, is used hypodermatically, sometimes; but the alkaloid *eserine* is to be preferred.

℞ Eserinæ sulph. vel salicylat., gr. j; aquæ, ʒ iv. M. Sig.: Four (4) minims contain $\frac{1}{60}$ of a grain.

PILOCARPINA—*Pilocarpine*. ℞ Pilocarpinæ hydrochlorat., gr. xvj; aquæ, ℥ j. M. Sig.: Five (5) minims contain ($\frac{1}{6}$) one sixth of a grain.

AMYLI NITRITUM—*Nitrite of Amyl*. From three (3) to five (5) minims of amyl nitrite can be injected subcutaneously at a time. The repetition of the dose will depend on the effect, but the injection may be practiced every half hour for a time.

CHLOROFORMUM PURIFICATUM—*Purified Chloroform*. From five (5) to fifteen (15) minims can be used at one injection. This agent is employed by the "deep method"—i. e., the chloroform is thrown by the syringe deeply and in the neighborhood of the nerve-trunk, the seat of pain.

The official *spiritus chloroformi* has also been used successfully in the same group of cases.

ALCOHOL and ETHER are also injected subcutaneously—alcohol in the diluted form, as whisky or brandy, and pure ether.

CHLORAL HYDRATE. ℞ Chloral. hydrat., ℥ ss.; aquæ, ℥ j. M. Sig.: Thirty (30) minims contain fifteen (15) grains of chloral.

Sometimes it is advantageous to give chloral and morphine together.

CAFFEINA—*Caffeine*. ℞ Caffeinæ, gr. xxiv; glycerinæ, aquæ, āā ℥ ss. M. Sig.: Twenty minims contain one grain.

APOMORPHINA—*Apomorphine*. ℞ Apomorphinæ, gr. j. Ft. pulv. no. xvj. Sig.: One or more may be dissolved in sufficient water as required.

Apomorphine undergoes a change in the presence of moisture, especially when kept in solution for some time; hence the solution for hypodermatic injection should be prepared when required. The dose ranges from $\frac{1}{16}$ of a grain to $\frac{1}{8}$ of a grain.

ERGOTA—*Ergot*. ℞ Ext. ergotæ, ʒ j; aquæ, ℥ j. M. Sig.: Twenty minims contain two (2) grains.

QUININA—*Quinine*. "℞ Quininæ disulphat., gr. l (50); acid. sulphuric. dil., ♏ c (100); aquæ font., ℥ j; acid. carbolic. liq., ♏ v (5). Solve.

"Place the quinine and water in a porcelain dish over a spirit-lamp; heat to the boiling-point, and add the sulphuric acid, stirring with a wooden spatula. Filter at once into a bottle, and add the carbolic acid. This gives six grains to the drachm." [Lente's formula.]

Quinina bimuriatica carbamidata, a combination of quinine and urea, is freely soluble—in equal parts of water, in fact—and therefore a most useful preparation for hypodermatic use.

℞ Quininæ hydrobromat., gr. xlviij; aquæ destil., ʒ iv. M. Dissolve, and by heat if necessary. Sig.: Twenty (20) minims contain 4 grains.

The new antipyretics, antipyrine, acetanilid, exalgine, and some others, having been found to possess analgesic power, are now used hypodermatically for the relief of certain kinds of spasmodic and painful diseases.

Acidum Carbolicum—*Carbolic Acid.* ℞ Acid. carbolic. purif., gr. x; aquæ, ℥j. M. Sig.: Eight minims contain $\frac{1}{6}$ of a grain.

The quantity administered will range from one sixth of a grain to two or three grains.

Hydrargyrum—*Mercury.* The solutions of mercury now chiefly used are those of the corrosive chloride, the albuminate, and the formamide, as prepared by Liebreich.

℞ Hydrarg. chlor. cor., gr. j; aquæ, ℥j. M. Sig.: Ten (10) minims contain $\frac{1}{48}$ of a grain.

Various albuminous solutions of mercury have been proposed: the chlorides of mercury, ammonium, and sodium, mixed with albumen.

Arsenicum—*Arsenic.* The preparations of arsenic used hypodermatically are the official solutions and the cacodylates, chiefly cacodylate of sodium, of which one grain is given in sterilized solution.

Aquapuncture.—By *aquapuncture* is meant the injection of pure water beneath the skin. A special instrument has been invented to effect this; but ordinarily a hypodermatic syringe will suffice for this purpose. From a half-drachm to a drachm is thrown under the skin over the organ or part on which it is intended to act.

Irritant Injections.—Injections intended to excite local inflammation are also employed in various morbid states. The materials so used, and the conditions requiring them, will be set forth hereafter.

Injections of Organic Liquids.—When the experiments made by Brown-Séquard with testicular juice were published, an extraordinary degree of attention was attracted to the subject, and presently there were brought forward trials made with extracts from various organs besides the testes—with the thyroid gland, the pancreas, the brain and spinal cord, etc. Not a little ridicule attended the subject of testicular juice on its first announcement, but subsequent experience has fully confirmed the statement originally made by Brown-Séquard, and now the remarkable restorative power of this fluid injected subcutaneously is admitted by all scientific authority concerned with this subject. According to Poehl, of St. Petersburg, the effect of testicular juice is due to the presence in it of *spermine*, a principle which accelerates oxidation by contact. But by Brown-Séquard and his assistant, D'Arsonval, the effects are ascribed to a ferment action, a diastasic power which acts as a succedaneum, or replaces the natural ferment produced by the testes and other organs. In that disease caused by atrophy of the thyroid gland and known as myxœdema, the injection of thyroid juice brings about a marvellous change in the condition of the patient, and is rapidly curative. When the testicular juice is injected the vital resources are remarkably re-enforced, and the individual declining into decrepitude of old age, the invalid exhausted by illness or wasting disease, etc., receives a new instalment of life as it were, for all the functions are performed with increased vigor. Spermine does not possess such powerful reconstituent qualities, and cannot therefore be substituted for the testicular juice.

The mode of preparing the extract or juice, as described by D'Arsonval, is as follows: The testicle of the bull, which is preferred, is brought to the laboratory, enveloped in its membranes, which are removed and the organ washed in a 10-per-cent solution of corrosive sublimate, followed by douching with sterilized water. The testicle is then divided into five or six parts and placed in aseptic glycerin, and allowed to macerate for twenty-four hours—one litre (= 32 oz.) of glycerin being used for every kilogramme (= 2·2 lbs.) of testicle. A solution of common salt, 25 grm. (= 6¼ drs.) in 500 c. c. of boiled water, is added to the glycerin solution. It is then filtered through sirup paper (Laurent's gray filter No. 8). If the temperature of the fluid is raised to 104° Fahr., the filtration goes on rapidly; if cold, but slowly. According to D'Arsonval, this solution should be sterilized by subjecting it to a pressure of 30 atmospheres of carbonic acid, and he has invented an ingenious apparatus for effecting this. (*Bul. Gén. de Thérap.*, February 28, 1893, p. 151.)

Constantin Paul's extract of the gray matter of the brain is prepared in a similar manner. He makes use of the gray matter of the sheep's brain. Of this, 15 grm. (= ℥ .5), finely minced, is digested for twenty four hours in five times its weight, or 75 grm. (= ℥ 2.5, or three ounces), of pure glycerin. To this is added the same quantity, or ℥ 2.5, of a solution of common salt, 12 per cent in strength. The dose of this is one c. c. (= 16 minims) once a day or once in two days. Of D'Arsonval's testicular fluid the dose ranges from 10 to 20 minims. It need hardly be observed that in using the testicular solution or the cerebral, the utmost care is necessary to keep the instruments aseptic, and it is useful also to wash the parts where the injection is to be made with 1 : 1,000 solution of corrosive sublimate, or 2 : 100 of carbolic acid.

Besides the organic extracts above mentioned, there have been introduced into practice various preparations of the same character, obtained, however, from other organs. The thyroid body, the suprarenal bodies, the kidney, spleen, bone-marrow, and other parts, furnish extracts for subcutaneous injection. It need hardly be stated that such solutions must be prepared under the strictest antiseptic precautions, to avoid serious accidents. Of those that have been used, it is certain that the extract of the thyroid body has been the most successful; but the internal use of the gland itself has almost taken the place of the subcutaneous method, as being painless and also far safer. Among the other animal extracts, that of the red-marrow of bones in anæmia, of the suprarenal bodies in Addison's disease, and of the kidney in chronic interstitial nephritis, have been most useful. In another section fuller information will be given on the subject of the antitoxins and their applications to the treatment of septic states.

We have to note that sodium phosphate has been proposed by Crocq, and by Luton, of Rheims, as a substitute for the organic matters. Crocq proposes a solution as follows: Sodium phosphate, 1 grm. (= 15·5 grs.); glycerin, 20 grm. (= 310 grs.); distilled water, 25 grm. (= 387 grs.); alcohol, 5 grm. (= 75 grs.). The dose is 3 c. c. (nearly 50 minims) every day or on alternate days by subcutaneous injection. The usual antiseptic precautions are to be observed throughout. Luton makes use of a solution of crystallized phosphate of sodium and sulphate of sodium. The advocates of this remedy maintain its equality in curative power with the organic solutions.

HYPODERMATOCLYSIS.—By this name Cantani, of Naples, has introduced a method of treating cholera, which, as the title imports, is an extension of the ordinary hypodermatic injection. The syringeful is the maximum as a rule by subcutaneous injection, but a much larger amount is made use of by hypodermatoclysis. Hence, while a perforated needle is necessary to penetrate the skin, a reservoir much larger than the syringe is required for containing a solution that is from one to two litres (quarts) in amount. Nothing is better for this purpose than the fountain syringe with its flexible tube terminating in the perforated needle. The force with which the fluid is made to pass under the skin is regulated by the elevation at which the fountain is placed. It should not be forced at such a rate as to cause painful distention of the skin. The lump which forms by the inflow of the liquid may be dissipated by careful massage; but if a site where the areolar tissue is abundant has been selected, the ordinary rate of absorption will suffice to dispose of the solution as it is introduced. The apparatus must be sterilized in boiling water; the solution must be allowed to flow enough to displace the air, and care should be used to prevent the introduction of foreign matters. The solution employed contains common salt, about 4 grammes = ʒj; sodium carbonate, 3 grammes = 45 grains, dissolved in one litre = one quart, of sterilized water. This amount of fluid is inserted at one time, and is subsequently repeated as required. That is known as "Samuel's continuous method" in which the fluid is made to flow continuously until several litres are injected. The temperature of the fluid should be 104° to 105° Fahr., or higher if it can be borne—that is, when cholera is the disease being treated—and it should not be lower than 100° Fahr. in any case. The introduction of so large an amount of fluid must necessarily cause some local irritation, swelling, and tenderness, but it is rare that an abscess results.

It is not only in cholera that the method of hypodermatoclysis is resorted to. It has been proposed as a substitute for transfusion of blood in some of the cases requiring filling of the blood-vessels; as in hæmorrhage, where the loss of blood threatens heart-failure; in acetonæmia, or diabetic coma; and in cases where rapid decline is the result of an acute septic inflammation, as in peritonitis.

Infiltration Anæsthesia.—Schleich's method. Closely allied to the method of subcutaneous medication is the plan of inducing anæsthesia by injection into the skin itself, so as to obtain the pressure of the fluid on the nerve endings and the local action of the anodynes simultaneously. The agents employed for this purpose are cocaine, morphine, and common salt—the last method being used because of its physical properties. Some of the newer anodynes, especially eucaine "a" and "b," have lately been proposed as substitutes for cocaine, but the most recent researches have shown that cocaine is in all respects the most desirable for the production of local anæsthesia. Of course, the principle of this method is to procure the most effect with the least expenditure of material. Various formulæ are to be found on page 611. To avoid untoward results, the solution must be used, for such a number of punctures is made as the seat of pain or the length of the incision may require. The fluid injected must be sufficient in amount to cause a wheal to arise at that point, and they must be numerous enough to render the whole surface to be operated on entirely anæsthetic. It must not be forgotten that the point of the needle is passed into, and not through, the true skin, if the operative procedure is to be confined to this tissue. When the desired area of skin has been rendered anæsthetic the fluid can then be injected into the subcutaneous tissue, and into the deeper parts exposed in the course of a surgical operation. When thus inserted into the skin an incision can be made without pain, a small tumor removed, an abscess opened, or a small unimportant operation performed. The same method is applicable to the treatment [illegible] the pain of a local inflammation. When [illegible] is the seat of an acute hyperæmia [illegible] anæsthesia is practiced around or about [illegible] the sensibility is so far reduced [illegible] without suffering. [illegible] preferable to make use of [illegible] several ingredients. They [illegible] made sterile by boiling. [illegible] of the method is the [illegible] anæsthesia practiced [illegible] this method the [illegible] appreciable.

IV.

BY THE VEINS.

The injection into the veins of medicinal agents is dangerous or not, according to the character of the material so used. Numerous experiences have demonstrated the safety of ammonia injections, and Prof. Ore, of Bordeaux, has practiced the intra-venous injection of chloral to induce anæsthesia. Formerly, before the introduction of the hypodermatic method, the injection of medicines directly into the blood was suggested and occasionally practiced in cases of asphyxia, in the collapse of cholera, in the insensibility due to narcotic poisons, etc. At present this method is restricted within narrower limits. Some remarkable results have been obtained by the injection of a saline solution into the veins in cases of the *collapse of cholera.* The first trials with the intra-venous injection of salines were made in 1832 with little success, but in succeeding epidemics greater confidence was felt in the remedy, and in 1866 it came to be used quite freely. For example, in 1867, Little, reporting on his experiences, gave an account of five recoveries out of twenty cases in an apparently hopeless state. During the epidemic of 1892 at Hamburg, Havre, Paris, Berlin, and elsewhere intra-venous injections were practiced on a large scale and with a greatly increased measure of success, so that it has now become a practice of the first importance in the treatment of the algid stage of cholera. The same method is also employed in the treatment of hæmorrhage instead of transfusion of blood in cases of sudden heart-failure, in diabetic coma, and other states.

The injection of salines into the veins is also entitled intravenous infusion. By means of a suitable apparatus the fluid is poured into the veins. The simplest arrangement for this purpose consists of a reservoir for containing the requisite amount of solution, a flexible tube for conveying the solution, and a suitable perforated needle for transfixing the vein. There are various patterns of instruments for effecting the intravenous injection, but if the right conditions are complied with the least complicated may be used with complete success. The fluid must be a saline solution, so as not to coagulate the blood or to dissolve the blood globules ; it must be sterilized, so as not to convey germs ; it must be at the right temperature ; and it must be passed into the blood without at the same time carrying globules of air. The amount to be inserted need not exceed a few ounces. Even when the loss of blood has been enormous, or when the serous discharges have brought on collapse, a few ounces of saline fluid suffices to restore the circulation. Recent experiences have apparently shown that even in great loss of blood it is not so much the blood itself that is needed, but a small quantity of serous fluid apparently suffices.

Hayem recommends the following formula as a close approximation to the composition of blood-serum :

Water	3 oz.
Hydrate of sodium	15½ grains.
Chloride of sodium	80 grains.
Sulphate of sodium	6½ drachms.

The temperature of the fluid injected should not be greater than 100° Fahr., and the amount which experience has shown to be well supported is not greater than two litres, and usually one litre (a quart) is sufficient for one operation. The fluid should be injected slowly, according to Potain, at such a rate that not more than 20 cubic centimetres pass into the blood in a second. Dr. Histon Fagge has recently reported a case of *diabetic coma*, in which the injection of twenty-six ounces of a warm solution of salines (phosphate and chloride of soda) produced an astonishing improvement in the condition of the patient. A suitable saline solution for intra-venous injection may be made of phosphate, carbonate, and choloride of sodium, dissolved in water at the temperature of 100° Fahr. until the specific gravity of 1020 is attained. The instruments employed for transfusion of blood may be used for the intra-venous injection of salines.

Halford, of Australia, has successfully practiced the *injection of ammonia* into the veins, in the treatment of the bite of venomous snakes. He employs one part of the stronger *aqua ammoniæ* to two parts of distilled water, the injection being made with an ordinary hypodermatic syringe. A vein in a convenient situation is selected, the needle is inserted into it, and the solution of ammonia is thrown in gradually. The operation may be repeated, as necessary, the guide to the repetition of the injection being the state of the circulation. Fayrer shows that this practice is not successful in the systemic condition caused by the bite of the venomous snakes of India, and the special committee of the Medical Society of Victoria, appointed to investigate the subject of the intra-venous injection of ammonia, report adversely to the claims of Halford. The proposer of this expedient has, at least, demonstrated the safety of the intra-venous injection of ammonia ; and, although his first claim has been shown to be incorrect, the method itself has been utilized in other maladies : for example, in *chloroform asphyxia*, *opium narcosis*, *hydrocyanic-acid poisoning*, etc. Failure of the heart's action and *thrombosis of the pulmonary artery*, *post partum*, are also indications for the intra-venous injection of ammonia.

Attention has been called elsewhere to an instance reported by Dr. Eskridge, which is remarkable both as to the injection and as to the results obtained. By an error, undiluted aqua ammonia was injected directly into the blood-current, but no untoward effects accompanied or followed, and the curative action exerted in the malady was most successful. Although, at one time, the escape of ammonia was supposed to be the cause of the coagulation of the blood, and although this is no longer held as a theory, it has served to demonstrate the fact that such intra-venous injections can be practiced without ill effects, immediate or remote.

Transfusion.—This consists in an operation for substituting healthy blood for the abnormal fluid occurring in certain diseases, and for supplying blood in cases in which a deficiency exists by reason of hæmorrhage. Ordinarily the blood of a healthy adult is used in transfusion, because ever since the time of Blundell it was supposed the blood of an animal would not functionate properly in the arterial system. This notion is now, however, fully exploded, and Gesellius has especially shown, in his elaborate monograph on transfusion, that lamb's blood will answer the same purpose in the human system as human blood.

As the red globule is the vivifying constituent of the blood, and as the fibrin is non-essential to the most important office, at least of the circulating fluid, it is obvious that defibrinated blood may be used for transfusion. According to the statistics collected by Gesellius, of one hundred and forty-six cases of transfusion with blood without defibrination, seventy-nine, or 54·11 per cent, were successful, and, of one hundred and fifteen cases in which defibrinated blood was used, seventy-nine, or 68·70 per cent, proved fatal. Mr. Higginson, of Liverpool, reports thirteen cases occurring under his own observation, in which mediate transfusion with pure blood was employed, with the result of six successful. The injection of defibrinated blood is free from one source of danger—the introduction of clots into the circulation—which, as Panum has shown, will be followed by the disastrous result of multiple embolisms, or thrombus of the pulmonary artery. Separating the fibrin, however, renders the blood much less capable of performing its office. The necessary agitation in order to coagulate the fibrin injures the blood-globules, and the fibrin itself is necessary to prevent transudations and the recurrence of hæmorrhage. With the improved instruments now used for the operation, and with the exercise of the necessary care, there need be no formation of clots, the chief danger in the use of blood containing its fibrin.

Transfusion may be *mediate* or *immediate*. Mediate transfusion consists in the reception of the blood in a suitable vessel, and its transference by means of an injecting apparatus into the veins of the patient. Immediate transfusion consists in an apparatus for making direct communication, from the vein of the person or animal furnishing the blood, with the vein of the patient receiving it. A number of appliances have been invented for mediate transfusion. Martin, of Berlin, has used in his operations a glass syringe provided with a suitable canula for insertion into the vein. Belina invented an apparatus consisting of a receiver for the blood, a hand-ball like that of the spray-douche, and a flexible tube provided with a stop-cock and canula. Belina, who has treated at great length of the operative procedure, decides that all forms of syringes are objectionable. Higginson proposed and has used successfully an instrument similar to the enema-syringe invented by him. This apparatus can, however, only be used for mediate transfusion. As immediate transfusion is to be preferred, as a rule, it were better to be provided with a suitable instrument for this operation. The instrument invented by Dr. Aveling, and presented to the Obstetrical Society of London in 1864, is at the same time the simplest and most effective. This consists of a hand-ball and flexible tubes like a Davidson syringe, but without valves. There are two canulæ attached to either extremity of the flexible tubes—one for insertion into the vein furnishing the blood, and the other for insertion into the vein receiving it. The small-sized Davidson syringe will answer perfectly well by removing the valves, the action of which tends to separate the fibrin, and fitting to the flexible tubes suitable perforated needles or canulæ. In using Aveling's instrument it must be first put into water at the temperature of 100° Fahr., and it must be filled with warm water, or better, a warm solution of phosphate and chloride of sodium of a specific gravity of 1020. The object of this is to exclude the air from the apparatus. The next step consists in inserting the canula in a vein—usually of the forearm—of the person or animal furnishing the blood, and in a position so that the blood-current will be in the direction of the current in the patient receiving it. Should the veins of the patient be collapsed, the skin overlying those at the elbow may be transfixed and raised, which will bring into view a vein into which the canula may be inserted—care being used here that the direction of the current shall be toward the heart. The canulæ can be held in position by the fingers of assistants. The operator compresses the bulb gently, pressing at the same time the supply-tube between the thumb and finger of the other hand, in order to prevent a reflux of the fluid. When the bulb is emptied, the delivery-tube is pressed between the thumb and finger shifted from the supply-tube, and the bulb is allowed to fill with blood from the source of supply. In this way, successive charges of fresh blood can be delivered without difficulty into the patient's vein. The *aspirateur* may be used in the same way for immediate transfusion, as has been suggested by Dr. J. W. Howe, of New York, who has used it successfully. He advises the substitution of smaller tubes than those which accompany this instrument, and he has devised suitable canulæ for the veins.

The quantity of blood which it is advisable to introduce varies from four to eight ounces. The smaller amount is generally more successful. Too large an amount will seriously embarrass the heart. A further precaution is necessary as to the manner of injection; force is never necessary, and may be very injurious; the blood should be delivered into the vein slowly and gently.

Besides the danger arising from coagulation of the blood and the formation of thrombi, immediate bad symptoms or fatal syncope may come on from the introduction of air into the veins. The utmost care is necessary to exclude air from the apparatus. Phlebitis may also ensue from the injury done to the vein, and the patient's life be put in jeopardy from this cause, but this is a danger much more remote than the introduction of air and clots into the circulation.

As a number of successful cases of transfusion (Gesellius, Hasse, and others) have been reported in which lamb's blood was used, the practitioner is now justified in its employment, notwithstanding Landois has shown by experiment that transfusion of mixed blood does injury to the red blood-globules. If lamb's blood is to be used, the animal should be sufficiently anæsthetized to keep it quiet, and it should be securely tied. A vein may be selected, and immediate transfusion performed with Aveling's instrument or with the *aspirateur* in the mode already described.

Transfusion is especially indicated in cases in which life is put in imminent jeopardy by *hæmorrhage.* According to Belina, it is in hæmorrhage from *abortion,* and during the first months of pregnancy, that transfusion is most successful. Of thirteen cases of hæmorrhage from abortion thus treated, according to this author, eleven had a fortunate issue. Of the cases of *post-partum hæmorrhage*—eighty-five in number—in which this expedient was adopted, fifty-six resulted favorably. Routh, Soden, Hicks, McDonnell, Mudge, Howe, and others, have reported successful cases, not included in the statistics of Belina. In other forms of hæmorrhage, *hæmatemesis, intestinal hæmorrhage, epistaxis,* etc., in which death by exhaustion is imminent, the operation of transfusion is proper. Belina has collected twenty-six cases of *traumatic hæmorrhage,* of which twelve resulted favorably, in two the result was doubtful, and twelve terminated fatally.

Transfusion has also been employed in certain morbid states of the blood, but not with encouraging results. Thus, Belina has collected a number of cases belonging to this category, of which nineteen terminated favorably, in two the result was equivocal, in three temporarily beneficial, and thirty-nine died. Two very interesting cases of the *hæmorrhagic diathesis* successfully treated by transfusion have been reported by Dr. Joseph Buchser, of New York. This form of constitutional cachexia is especially an indication for transfusion. In the treatment of *anæmia* this operation has not been successful. Thus, three cases treated by Stohr, of Würzburg, terminated fatally. Cases have also been reported by Concato, Cavaleri, and others. Transfusion has been used very successfully in cases of carbonic-oxide poisoning (Uterhart, Prof. König, Prof. Martin), and in phosphorus-poisoning (Prof. Jürgensen).

Eulenburg and Landois advise transfusion in cases of danger to life from poisons for which there are no antidotes. It has been recommended, in such cases, to abstract blood and to supply fresh blood to the suffering organism. Nussbaum has employed transfusion with complete success in *epilepsy*, and it has also been used with favorable results in *eclampsia* due to *uræmic poisoning*.

Arterial Transfusion.—Prof. Albanese has proposed injection of defibrinated blood into an artery, either the radial or posterior tibial, as a substitute for the intra-venous injection. The artery is exposed, punctured, and the blood thrown into it, in the same way as in the operation on the vein. It is claimed for this method that thrombosis is less apt to occur, and that the danger arising from the introduction of air is obviated. When a large amount of blood is necessary, it is more safely introduced by the arterial system, because, having to traverse the capillaries before reaching the right side of the heart, sudden distention of this organ is avoided. Prof. Hüter, who has especially advocated this method, reports a number of cases successfully performed in this way, and Asché has collected a number of others.

Transfusion of Milk.—The experiments of Donné on animals demonstrated the harmlessness of the intra-venous injection of milk. Hodder, of Canada, was the first to employ this expedient on man; and, of three cases of *cholera collapse* which he thus treated, two recovered. Thomas, of New York, has also transfused milk with success in *post-partum hæmorrhage ;* and Wagstaff has failed twice with the same method in *traumatic hæmorrhage*. Within the present year (1880) Mr. Arthur Meldon has published an account of three cases in which the transfusion of milk was performed with success.

When milk is used for transfusion, it should be fresh and directly from the cow if practicable, and its temperature should be that of the blood itself—100° Fahr. Not more than four to six ounces should be injected at one time, lest the heart be paralyzed by over-distention. The effects which follow the intra-venous injection of milk are very much the same as those produced by blood, except that they are probably less permanent, and that albuminuria is a frequent result. That this expedient is as useful as blood transfusion by the immediate method has been strongly maintained, but the most recent experience does not justify this opinion. Indeed, it is probable that the chief value of blood transfusion, in functional diseases, is to gain time for the operation of other and more permanent measures (Pepper). We also agree in the estimate of Dr. Pepper that transfusion in any of its forms is without utility in important organic diseases.

In an experimental inquiry into the methods of transfusion, Schafer has examined anew the question of the substitution of some other fluid for blood, deciding with Landois, of Germany, and Howe and Dupuy, of America, that the introduction of any other fluid does injury to the corpuscles, and that a fluid without hæmoglobin can not functionate as blood. As respects the substitution of the blood of some other animal—lamb's blood, for example—the conclusion of Schafer is in accord with the previously expressed judgment of Landois, that only human blood should be used in transfusion on man. Schafer has also made some important observations on the best mode of performing the operation. He finds that the best results are obtained on animals by arterial transfusion, and recommends that the dorsal artery of the foot be used for receiving and furnishing the blood in the operation on man. When the artery is used the blood is received into that part of the vascular system where it is most needed, and only an elastic rubber tube and glass canula are required, the force of the donor's circulation being sufficient to propel the blood. There is no danger of the supply from the donor becoming excessive, as the pressure in the arterial systems of the donor and of the recipient soon acquires the same force. Usually, and indeed unless the circulation in the donor is feeble, no other medium of communication is necessary besides the flexible tube and glass canula, as the elastic pump of Aveling's instrument does not contribute to the force of the flow. The tube and canulæ should be filled with carbonate-of-soda solution, both to exclude air and to prevent clots forming. It is not necessary to measure the quantity of blood, as the condition of the recipient furnishes the true indications to be followed.

Peritoneal Transfusion.—To the various kinds of transfusion must now be added this form, originally proposed by Ponfick. With antiseptic precautions, a trocar with canula is passed through the abdominal walls in the linea alba. A flexible tube, with a glass funnel attached, is then connected with the canula—the trocar being withdrawn—and defibrinated blood is poured into the cavity. Excellent results follow this practice, which the researches of Bizzozero and Golgi have shown to be based on sound physiology. This method has been used successfully by Von Kaczorowski and others in the various maladies in which the other modes of transfusion have been employed. Some adverse reports have, however, been made. Peritonitis has been caused by the procedure, but in these cases the subjects operated on may have been unsuitable ones. On the whole, peritoneal transfusion, which at one time promised to be a valuable measure, must be regarded as still *sub judice*—if, indeed, its utility is not questionable.

Dr. Joseph W. Howe, of New York, who has made many valuable observations on transfusion, in a recent issue of the "New York Medical Journal" (February 3, 1883), announces that no other expedient can be properly substituted for the intra-venous injection of blood. When life is endangered by hæmorrhage, Dr. Howe holds that it is not advisable to wait for intestinal or peritoneal absorption, but that intra-venous transfusion should be practiced without delay.

Infusion of Salt Solution.—The solution of common salt—from 1 to 5 per cent—in distilled and sterilized water, is employed for this purpose. A fountain syringe with a suitable needle for transfixing the skin is the simple instrumental means required. The hypodermatic needle is suitable for most of the cases, but longer and larger needles may be necessary in special cases. The best places for practicing the infusion are those where the skin is loose and the space most abundant, as in the armpits, in the lumbar and inguinal, and in the popliteal regions. The pressure obtained by elevating the reservoir determines the rapidity with which the solution enters the subcutaneous connective tissue. The effect of the infusion on the powers of life is remarkable. In fact, it has been found that the method of infusion of salt solution is nearly equal to the intravenous injection of the same, or to transfusion of blood. This procedure has greatly developed in the last few years, and is freely used in conditions of depression of the powers of life, the result of hæmorrhage or exhausting discharges, in uræmic convulsions, in diabetic coma, and in many cases in which heart failure is threatened by sudden losses of fluid, or by unexpected weakness of the centers presiding over important functions.

V.

PRESCRIPTION WRITING.

The Troy System.—Until the Pharmacopœia of 1890 appeared, the weights used in compounding drugs were from the Troy pound, and the measures from the wine gallon. These are still largely, indeed, chiefly used. The edition of the Pharmacopœia of 1890 adopted the metric system, and hence it is necessary for the prescriber to be familiar with both.

Certain symbols are employed in representing weights:

The pound is represented by........	"libra"	(℔).
The ounce........................	"uncia"	(℥).
The drachm.......................	"drachma"	(ʒ).
The scruple......................	"scrupulum"	(℈).
The grain........................	"granum"	(gr.).

The measures of quantity from the wine gallon are also represented by certain symbols, as follows:

The gallon is represented by.....	"congius"	(C).
The pint......................	"octarius"	(O).
The fluid ounce................	"fluiduncia"	(f℥).
The fluid drachm...............	"fluidrachma"	(fʒ).
The minim.....................	"minimum"	(♏).

The letter "f" is placed before the symbols for ounce and drachm respectively.

The domestic measures are nearly as given below:

A teaspoon contains about................	1 drachm.
A dessertspoon " "	2 drachms.
A tablespoon " "	4 "
A wineglass " "	2 fluid ounces.

Usually the measures of weight are used to represent quantity as well. In that case the same symbols may represent both. In prescribing liquids the letter "f" is generally made to precede the symbol, for the reason that some liquids weigh more, others less, than the indicated quantity.

Terms Used in Prescription Writing.—A medical prescription is a formal expression of the physician's instructions addressed to the authorized compounder of medicines—the apothecary. The word "prescription" is derived from the Latin "præ," before, and "scribo," I write, or "scriptum," written. Prescriptions are written in Latin, as are also the formulæ of the present Pharmacopœia. The reasons for the continued use of Latin are long custom, and because Latin, a dead language, is not subject to the variations of form and meaning—the fluctuations—of a living language, which is frequently adopting new words and terms, and changing the meaning of the old.

Long usage has given a special form to medical prescription. It is made up of the *basis*, or chief ingredient; the *adjuvant*, or modifying material; the *corrigent*, or correcting substance; the *excipient*, for the proper combination of the whole into a uniform body; and the *vehicle*, for containing all in a uniform solution, mass, or mixture. In actual practice this is much simplified.

In writing a prescription it is usual to begin with the letter R crossed thus, ℞, and this signifies "recipe," "take," and is an imitation of the invocation to Jupiter, with which the ancient physicians began their prescriptions. In constructing a prescription the proper Latin form, so far as necessary, should be adhered to. The word "recipe" governs the object in the accusative, and here the object is the quantity of the several ingredients composing the prescription. The quantity in grains, drachms, or ounces governs the medicament in the genitive, represented by the English preposition "of." Thus, ℞, "recipe," take, for example, one scruple, "scrupulum unum," of sulphate of iron, ferri sulphatis, "ferri" and "sulphatis" being the genitives of "ferrum" and "sulphas." The same construction obtains for the adjuvant, the corrigent, and for the vehicle. In prescriptions as usually written, the excipient is rarely given, the addition of this being left to the judgment of the compounder. When the several parts or ingredients have been written, then follows the instructions as to form. If all ingredients are liquid, the prescriber may content himself with simply writing under their names and proportions the first letter of the word mix, Latin "misce." If pills or powders are intended, then, in addition to M., should be written M. div. in. pil. no. xii, or M. ft. pil. or pulv. no. x, etc. When the form and number of the pills or powders are determined on, then follows the instructions directed by the word "signa" or the letter S., which signifies "write." There are a few rules for determining case, which the prescriber should be familiar with, as follows:

Rule 1.—The quantity is put in the accusative case, governed by the word "recipe."

Rule 2.—If no quantity is expressed, the substance ordered is put in the accusative.

Rule 3.—Adjectives agree with nouns in gender, number, and case.

The substance in the genitive case is governed by the word for quantity, as already mentioned.

The terminations of nouns and adjectives vary with the declension. Thus:

Nouns ending in "a" are of the first declension, and have their genitive in "æ"; as aqua, aquæ.

Nouns ending in "us," "um," "os," "on" have their genitive in "i"; as hydrargyrum, hydrargyri, etc.

All other nouns make their genitive in "s" or "is," as chloral, chloralis; but in some the termination is lengthened. Thus:

"as," genitive "atis," as acetas acetatis.

"is," genitive "idis," as anthemis, anthemidis.

"o," genitive "onis," as pepo, peponis.

"x," genitive "cis," as cortex, corticis.

A few prepositions are used in the construction of prescriptions. They are the following:

"Ad," to; "ana," of each; "in," into; "cum," with.

Of these, "ad" and "in" govern the accusative, "cum" the ablative, and "ana" the genitive.

Other phrases with their abbreviations follow:

Quantum sufficiat	q. s.,	a sufficient quantity.
Granum	gr.,	a grain.
Gutta	gtt.,	a drop.
Semissis	ss.,	a half.
Pilula	pil.,	a pill.
Chartula	chart.,	a powder.
Mistura	mist.,	a mixture.
Liquor	liq.,	a solution.
Pulvis	pulv.,	a powder.
Tinctura	tinct.,	a tincture.
Syrupus	syr.,	a syrup.
Aqua	aq.,	water.
Fluidus, adjective	fl.,	fluid.
Dilutus, adjective	dil.,	diluted.
Ana	aa.,	of each.

In writing the directions for a prescription, many of the verbs employed are abbreviated.

Thus, "fiant" and "fiat," make, "ft."; "misce," mix, M.

"Divide," Div., "Signa," write, S.

Prescriptions are extemporaneous or official. The latter are contained in the United States Pharmacopœia. For example, the compound cathartic pill. In directing an official combination of this kind, we proceed as follows:

℞ Pil. cathartic. comp. (U. S. P.) no. xii.
S. One or two pills at night.

These abbreviations are sufficiently clear to permit no mistake. If written out they would be:

℞ Pil. catharticæ compositæ no. xii.

There are but fifteen formulæ of official pills in the Pharmacopœia, and nine of these are purgative combinations. In prescribing them, the official title should be made use of. For example, Pilulæ ferri iodidi. To avoid the necessity of changing the termination, the word pilulæ is abbreviated into pil.

Among the products of the manufacturing pharmacist's art are compressed pills or "pellets," "tablets," or "tabloids," in which the pill mass is formed by the compressing machines. Although these preparations are not "official," rightly speaking, the official forms may be thus prepared.

In prescribing pills extemporaneously certain considerations must have due weight. The pill mass must not be too large. By common consent, the pill should not exceed five grains in weight. Deliquescent substances, those too great in bulk, oils, emetics, and stimulants are not suitable for this mode of administration. When the pill mass is bulky and the taste disagreeable, capsules are substituted, as in the examples given below. A few formulæ will suffice to show the mode in which extemporaneous prescriptions are constructed.

℞ Ext. colocynth. comp.	℈j;
Ext. rhei	gr. xij;
Ext. belladonnæ	gr. iij.

Misce et ft. pil. no. xii.
S.: One pill at night.

Or, instead of pills, the mass may be put into gelatine capsules, as follows:

℞ Quininæ sulphatis	ʒj;
Ferri sulphatis	gr. xij;
Extracti nucis vomicæ	gr. iij.

M. Ft. capsulæ no. xii.
S.: A capsule morning and night.

In these prescriptions the material used for forming the pill mass is left to the discretion of the pharmacist, whether he employs for this purpose syrup, gum, or acid.

A powder (chartula) is made use of when the medicament is bulky, not deliquescent, and not disagreeable to the taste. They are of various sizes, according to number and weight of the ingredients. When the taste is bad, or for the sake of convenience, the contents are put in a wafer instead of in a paper. The following is the mode in which a prescription for powders is written:

℞ Hydrarg. chlor. mitis	gr. j;
Sodii bicarb.	gr. xij;
Pulv. aromatic.	gr. vj.

M. div. in pulv. vel chartulas no. xii.
Sig.: One powder or wafer three times a day.

Mixtures (misturæ) are made by mixing fluid preparations, salts that can be dissolved in a suitable menstruum or held in suspension by agitation, or substances that may be diffused and held by the use of suitable excipients. Mixtures to be of proper consistency should hold certain proportions. For example, one fluid ounce should contain about one drachm of a vegetable powder and one scruple of a vegetable extract.

Emulsions are mixtures made by suspending an oil or resin—an oil by means of gum, or yolk of egg, or tragacanth ; a resin by means of an alkali ; and if a gum resin, the proportion of gum present suffices to suspend the resin. The U. S. Pharmacopœia recognizes four mixtures and four emulsions. Of the latter, two are made merely by triturating thoroughly with water, as emulsum asafœtidæ and emulsum ammoniaci. The emulsion of chloroform is made by triturating chloroform with oil of almond and gum tragacanth.

The following forms will show the manner of prescribing a mixture and an emulsion :

℞ Misturæ ferri compositæ...................... ℥ iv.
S. : A dessertspoonful three times a day.

℞ Emulsi ammoniaci.......................... ℥ viij.
S. : A tablespoonful as required.

℞ Bismuthi subnitratis......................... ʒ iij ;
Pulvis aromatici .... ʒ j ;
Mucilaginis acaciæ......................... q. s. ;
Aquæ menthæ pip...................... ad f ℥ iv.
S. : Two teaspoonfuls every four hours.

Suppositories (suppositoria). The Pharmacopœia recognizes but a single formula—suppositoria glycerini—beside the model. But it prescribes the size and form of the several kinds. Thus, "rectal suppositories" should be cone shaped and of a weight of about one gramme (15·4) ; "urethral suppositories" should be pencil shaped and of a weight of about one gramme (15·4) ; "vaginal suppositories" should be globular (or ovoid), and of a weight of about three grammes (46 grains).

The following prescription may serve as a model :

℞ Acidi tannici................................. ʒ j ;
Olei theobromæ.............................. q. s.
M. et ft. suppositoria vaginale no. vi.

Linimenta (liniments) are preparations for topical application, to be rubbed in with friction, and sufficiently active to cause some rubefaction, or they may have anodyne and vesicating properties. The United States Pharmacopœia recognizes nine liniments as official, and they are so various in composition and quality that it is rarely necessary to write an extemporaneous prescription calling for some other combination. In directing an official liniment, the nomenclature of the Pharmacopœia should be adhered to. For example :

℞ Linimenti ammoniæ.......................... q. s.
S. : Ammonia liniment—for external use.

Plasters (emplastra). There are thirteen official combinations contained in the United States Pharmacopœia (1890). The materials are of such consistency and firmness as to be spread on lead or resin plaster. When a plaster is ordered by prescription, the following procedure should be made use of :

℞ Emplastri picis cantharidati...... quantum sufficiat
fiat emplastrum ii.
S. : Warming plaster.

When a blistering plaster is desired, the following method is used:

℞ Cerati cantharidis .... q. s.
ft. emplastrum 11 × 11.
S. : Apply to seat of pain.

Besides the foregoing there are other forms for the prescription of medicinal agents, but as they are seldom used, and the principles governing them are the same as those above given, it is the less necessary to enter into further details.

The Metric System.—Since the introduction of the metric system, its use has become almost universal among scientific men as the standard of weights and measures. It was not, however, until 1890 that the United States Pharmacopœia adopted it for use in that work, and as it is likely to continue as the standard, it were well that all practitioners who have occasion to write prescriptions based on the official list of remedial agents should be familiar with it.

The metric system is based on the meter, which is the unit of linear measurements and is equivalent to 39·37 inches. The meter is subdivided into

Decimeter, or one tenth of the meter ;
Centimeter, or one hundredth of the meter ;
Millimeter, or one thousandth of the meter.

In writing prescriptions the decimeter is rarely employed.

The unit of weight is the gramme, which is the weight of one cubic centimeter of water at 4° C., the point of maximum density ; 1 gramme is equivalent to 15·432 Troy grains, and is written 1 ; 1 decigramme is equivalent to $\frac{1}{10}$ of a gramme, and is written ·1 ; 1 centigramme is equivalent to $\frac{1}{100}$ of a gramme, and is written ·01 ; 1 milligramme is equivalent to $\frac{1}{1000}$ of a gramme, and is written ·001.

The abbreviation for the gramme is gm. Quantities by weight are employed both for fluids and solids, but in a few instances it is necessary to allow for differences in specific gravity of some liquids.

Instead of Roman numerals, quantities are expressed in Arabic figures. Thus, for x is written 10.

The following rules for quantity should be remembered :

One Troy grain or minim is the equivalent of 0·06 gramme.

One drachm, or fluid drachm, is the equivalent of 4 grammes.

One ounce, or fluid ounce, is the equivalent of 30 grammes.

One gramme, or fluid gramme, is the equivalent of 15 grains or minims.

Four grammes, or fluid grammes, is the equivalent of 1 drachm.

Thirty grammes, or fluid grammes, is the equivalent of 1 ounce.

In writing a prescription by the metric method, it is usual to draw a vertical line to separate the grammes from the centigrammes and milligrammes—thus :

℞ Quininæ sulphatis	4	
Ferri sulphatis	1	
Extracti nucis vomicæ		5

M. Ft. pil. no. 30.

S. : One pill three times a day.

Or the same might be written without the line, but by decimal points, thus :

℞ Quininæ sulphatis	4·
Ferri sulphatis	1·
Extracti nucis vomicæ	·5

M. Ft. pil. no. 30 ; or, M. ut fiant pilulæ no. 30.

S. One pill three times a day.

One of the great merits of the metric system is its simplicity. Our French colleagues rarely use other weights than the gramme and centigramme, and although designating the article required in the terms of the French Codex in Latin, write the instructions and directions in their own tongue. It is best to conform to the French method in these respects.

As already remarked, in prescribing fluids by this system, parts by weight and volume are made to be mutually convertible. Some fluids, however, weigh considerably more than they measure ; others less. Thus, while one drachm or one teaspoonful of water weighs 3·75 grammes, the same quantity of chloroform weighs about 5·50 grammes, and the same quantity of ether only 2·80 grammes. Allowance must be made for these articles, but, generally speaking, parts by weight and volume are written in the same way.

In the following table the equivalents are sufficiently accurate to be employed in prescribing by the metric system :

Measures of Length.

1 meter is equivalent to	1·0936	yards.
1 " " " "	3·280	feet.
1 " " " "	39·370	inches.
1 centimeter is equivalent to	0·393	inch.
1 millimeter " " "	0·0393	"

Fluid Measures.

1 liter is equivalent to	1·0567	quarts.
1 " " " "	2·113	pints.
1 " " " "	33·814	fluid ounces.
1 " " " "	270·519	fluid drachms.

1 cubic centimeter is equivalent to 16·231 minims.

The following are the equivalents of metric weights in grains :

Milligrammes.		Approximate.		Exact equivalent.
·001	=	$\frac{1}{65}$ grain	=	·0154
·002	=	$\frac{1}{32}$ grain	=	·0308
Centigrammes.				
·01	=	$\frac{1}{6}$ grain	=	·1542
·02	=	$\frac{1}{3}$ grain	=	·3086
Grammes.				
1·00	=	15· gr.	=	15·434
2·00	=	ʒ ss	=	30·868
3·00	=	℈ij	=	46·302
4·00	=	ʒ j	=	61·736

PART II.

THE ACTIONS AND USES OF REMEDIAL AGENTS.

THOSE USED TO PROMOTE CONSTRUCTIVE METAMORPHOSIS.

ALIMENTS.

THIS extensive subject can, in this work, be considered briefly only, and from the point of view of therapeutics. The various aliments are of the first importance as remedial agents. No satisfactory repair of diseased or wasting tissues can take place without a suitable supply of healthy blood, and healthy blood is the product of proper food and normal digestion and assimilation.

THE PHYSIOLOGICAL RELATIONS OF FOOD.—The food of man is derived from the three great kingdoms of nature: mineral, vegetable, animal. It may be conveniently classified into three principal groups: 1. Mineral constituents—incombustible or unoxidizable: water, phosphate of lime, chloride of sodium, etc.; 2. Oxidizable—heat-producing and force-forming—carbon compounds: fat, sugar, starch, gum, etc. Nitrogenous — flesh-forming: albumen, fibrin, casein, etc.; 3. Food adjuncts—alcohol, acids (citric, tartaric, etc.), alkaloids (caffeine, theine, etc.).

The members of the first group will be discussed hereafter, under the head of "agents promoting constructive metamorphosis"; the second group, the most important, will be considered in this relation, with the foods; and the third will have separate treatment under appropriate heads.

The classification of foods, originally formulated by Liebig, if not too strictly adhered to, is of much utility, as indicating the general purposes of these substances in the economy—viz.: carbonaceous or force-producers; nitrogenous or flesh-formers. Under the first division are comprehended fat, starch, sugar, etc.; under the second, substances containing nitrogen, as albumen, casein, etc. There is not, however, a rigid line of separation between these two classes, for both are more or less concerned in the functions attributed to each, but their most important position and office are as assigned by the classification.

The ultimate uses of food are two: to construct tissues or repair them when destroyed by wear; to supply force—muscular, nervous, secretory, etc. The reception, digestion, and absorption of food is known as the *primary assimilation*; the utilization of the material for the growth and repair of the tissues, and by the organs, as force, constitutes the *secondary assimilation*.

The first step in the primary assimilation is the mechanical subdivision of the food by mastication. The admixture of the saliva with the food facilitates the process of mastication, and, as it contains a ferment, *ptyalin*, which has the property of converting starch into sugar, a portion of this constituent undergoes conversion; but, probably, the chief use of the saliva is to give a slight alkaline reaction to the mass of food. According to the laws of osmosis, the entrance of an alkaline fluid into the stomach hastens the formation of the acid gastric juice. In the stomach, under the influence of the ferment, *pepsin*, and the acid (hydrochloric) of the gastric juice, the nitrogenous materials—the albuminous constituents of the food, the proteids—are transformed into *peptones*. Although fat is necessary to the stomach digestion, it does not undergo conversion in the stomach, and escapes in a coarse emulsion, with the chyme, into the duodenum. Starch, sugar, and gum, also pass into the chyme unchanged, although separated from their proteid envelopes, by the action of the gastric juice, except such portions as may diffuse directly into the stomach-veins. The peptones, to a large extent, diffuse into the blood from the stomach, and doubtless, also, such crystalloidal substances as sugar, to some extent. The chyme contains parapeptones, starch, fat, sugar, and refuse matter remaining undissolved. In the duodenum the acid chyme mixes with the alkaline intestinal and pancreatic juices and the bile, which are poured out freely as the materials from the stomach distend the canal. Here the conversion of starch into sugar takes place actively, and the fats are emulsionized and to some extent, also, saponified. The pancreatic juice not only emulsionizes the fats, but separates them into their component fat acids and glycerin, and the acids meeting alkaline bases form soaps, which are readily diffusible. The action of the bile is also very important. It renders the soaps formed soluble, and promotes the emulsionizing of the fats. Its agency in the digestion of the fats is well shown in the results of the experiment for forming a biliary fistula. When the bile is conveyed externally, the amount of fat entering the lacteals is much below normal, and instead, the fat appears in the stools. In the small intestine the proteids which escape conversion in the stomach are transformed, under the agency of the bile, pancreatic fluid, and intestinal juice, into peptones and other substances, the starch is converted into sugar, and the fats are emulsionized, and in part, also, saponified. These nutrition materials diffuse into the portal veins and into the lacteals, so that, by the time the intestinal contents reach the ileo-cæcal valve, they are composed, for the most part, of excrementitious matters and the refuse of the foods taken.

When the nutrition of the body goes on in the normal manner, there exists a certain ratio between the income and the outgo. The income consists of the proteids, fats, carbohydrates, salts and water of the food, together with the oxygen absorbed from the atmosphere. The outgo is made up of the excreta of the respiratory act, consisting of carbonic acid and water with a little hydrogen; of the perspiration, composed of water and salts; of the urine, which contains the nitrogen excreted from the body and a large quantity of saline matter; and of the fæces, composed of excreta from the immense glandular apparatus of the ileum and colon, and from the liver. In a perfectly healthy condition of the body, after it has attained its full growth, there should be an exact ratio between the income and outcome; the income should suffice to furnish the force necessary for the performance of the various functions and to repair the waste of the outcome. In an ideal dietary, the amount of the food should be sufficient to maintain this ratio at the normal standard.

As respects classification of foods, for the purposes of this work, they may be considered under the natural divisions of *Animal* and *Vegetable.*

Animal.—One of the most important articles of diet for the sick is *Beef*, which should be of good quality. The bone should not exceed 20 per cent; the fat should be firm, not yellow, and free from blood, and should not be in too great proportion relatively; the muscle should be firm without being tough, not too pale, nor dark-colored, and should not present any marbling or lividity on cross-section. The most esteemed parts of the beef are the thigh and hip (round, sirloin, fillet), the loin, and certain parts of the shoulder (rib-roast, porter-house steak, etc.).

Beef varies much in composition, according to the age of the animal, the state of its nutrition, the kind of food-stuffs employed to fatten the beast, and the hygienic character of the animal's environments. The age should be four to five years, and the amount of fat appropriate to a well-kept and well-fed animal. The best proportions, taking the mean of various analyses, Continental and English, are about as follows:

Water	72·5
Nitrogenous matters, or albuminates	21·3
Fat	5·2
Extractives and salts	2·5

The composition of cooked meat, according to Moleschott (Parkes), is as follows:

Water	54·0
Albuminates	27·6
Fats	15·45
Salts	2·95

It will be perceived from the foregoing analyses that beef contains alimentary principles the most important for the nutrition of the body. When of good quality, neither too old nor too young, the fat and muscle suitably proportioned, and not altered by disease, and properly cooked, it is the best of the animal foods. The loss of lean beef in the process of cooking is about one third of the total weight; of fat beef, about one half. The time required for the complete digestion of beef, as ascertained by Dr. Beaumont, is two and three fourths to three hours.

Veal is less digestible and less nutritious than beef, and has a laxative action, which may, however, be utilized in states of disease. It has the following composition:

	Parts.
Water	63·0
Nitrogenous	16·5
Fat	15·8
Salts	4·7

As compared with beef, it is rather slow of digestion, requiring five hours or more. It is more albuminous than fibrinous, and abounds in gelatin (Fonssagrives). The thymus gland of the veal (*sweetbread*) is, when "plainly cooked (by boiling) and moderately seasoned, a very agreeable and suitable dish for the convalescent."—(Pereira.)

Mutton, although possessing a lower degree of nutritive value than beef, is one of the most useful of the animal foods, as it is easily digested. Many patients, however, experience a marked degree of repugnance to mutton and can not be induced to make use of any article of diet containing it. An evident idiosyncrasy exists in some constitutions against it, so that taken disguised in any way it disagrees with the stomach. It does not continue long in favor as the exclusive article of the meat portion of the diet, even with those who relish it for occasional use. According to Church, the following is the composition of mutton:

	In 100 parts.
Water	44·1
Albumen	1·7
Fibrin (true muscle)	5·9
Ossein-like substances	1·2
Fat	42·0
Organic extractives	1·8
Mineral matters	1·0
Other substances	2·3

Pork contains more fatty matter and more often disagrees than the meats above described. Many dyspeptics can not make use of it in any form : on the other hand, breakfast bacon may be much relished and be easily borne. Pork is rarely prescribed as a diet for the sick, but, for convalescents, roasted sucking-pig, which is easily digested, may be ordered to vary the food and to stimulate a languid appetite. Pork differs from beef and mutton in the relatively greater quantity of fat. The loss on cooking pork is 50 per cent. Pork, also, yields up to water less solid matter, for, while the solids contained in broth of beef and mutton were 27 and 33 per cent respectively, that from pork contained only 19 per cent. Beaumont found that roasted pork required five and one fourth hours for its solution and digestion in the stomach.

Bacon has the following composition, according to Church :

	In 100 parts.	In 1 lb.	
		oz.	gr.
Water	22·3	3	248
Nitrogenous matter	8·1	1	130
Fat	65·2	10	189
Salt	3·8	0	256
Phosphates, etc.	0·6	0	42

Venison has the following composition (Von Bibra) : Water, 74·63 ; albuminates, 19·24 ; fat, 1·3. When young and tender, it is palatable and easily digested, and, although inferior to beef in nutritive value, may be a useful addition to the diet of the sick and convalescent.

The domestic Chicken is a most important article of food for sick and convalescents. The taste is agreeable, the tissues soft and easy of mastication and digestion. "Spring chickens" are more tender and delicate than the fully-developed fowl of four or six months. Next to the chicken in point of digestibility is the domestic turkey, and after this the domestic goose and duck. Certain "game-birds," e. g., the prairie-chicken, wild-ducks, woodcock, snipe, are frequently prescribed for convalescents, and possess a high degree of nutritive value, but are not, of course, adapted for habitual use.

The viscera of certain animals are sometimes employed as food. Allusion has already been made to "sweetbreads," the thymus of the calf. The pancreas is very often substituted for the true sweetbread, and may, when in proper condition, be used instead of the thymus, but it is apt to be stringy and fibrous. The brain, tongue, heart, liver, kidneys, and alimentary canal, are occasionally eaten, but are not frequently prescribed for the sick. Brain is easily digested, and, as it contains fats in combination with phosphorus, may be usefully prescribed in conditions of disease in which these constituents are presumed to be deficient in amount. Liver, as ordinarily prepared by frying, is very trying to weak stomachs, but this food contains matters which may be utilized in certain diseased states. According to Braconnot (Pereira), the composition of liver is as follows :

Brown oil, containing phosphorus	3·89
Nitrogenous matter	6·07
Albumen	20·19
Salts	1·21
Water	68·64

Kidneys, especially as ordinarily prepared, are very difficult of digestion, and are unsuited for the sick. As they contain a notable quantity of urea and other excrementitious matters, they are for this reason objectionable articles of diet. Tripe, the stomach of ruminants, is very easily digested and very nutritious, when prepared in the simple way, only, which is advisable for invalids. It consists largely of albumen.

In order to test the relative value of the animal foods considered in the foregoing pages, Marchal de Calvi (Fonssagrives) made a series of elaborate examinations to determine the proportion of water and fat to the solid. The results were as follow :

ANIMAL FOODS.	FIRST ANALYSIS.		SECOND ANALYSIS.	
	Solid matters.	Water.	Solid matters.	Water.
Pork	294·50	705·50	302·50	697·50
Beef	277·00	723·00	275·00	725·00
Mutton	265·50	734·50	263·50	736·50
Chicken	263·50	736·50	263·00	737·00
Veal	260·00	740·00	255·50	744·50

These analyses assign to pork the first position. In another series of experiments M. Marchal used ether to dissolve the fat contained in the fibers of these meats. His results are expressed in the following figures :

ANIMAL FOODS.	Matters soluble in ether.	Matters insoluble in ether.
Beef	25·437	249·563
Chicken	14·070	248·930
Pork	59·743	242·757
Mutton	29·643	233·857
Veal	28·743	226·757

The following is the most recent contribution to our knowledge of the composition of these animal foods (Church) :

The composition of 1 lb. of

	Beef.		Mutton.		Pork.		Veal.		Lamb.	
	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.
Water	8	0	7	16	6	69	10	0	8	44
Albuminoids	1	122	0	385	0	315	1	199	0	360
Ossein-like substances	1	62	1	52	0	385	1	82	0	400
Fat	4	340	6	176	8	0	2	281	5	263
Mineral matter	0	350	0	245	0	105	0	312	0	244

According to these experiments, from the chemical point of view, beef has the highest nutritive value ; chicken ranks second, and is but little inferior to beef ; while veal is the lowest.

There are solid and fluid preparations of beef to which some reference should be made. *Scraped beef* is prepared by scraping with a case knife a strip of lean beef and separating the muscle pulp from the connective tissue. This may be thrown on to a hot skillet and quickly cooked on one side, when it is turned over to be acted on the reverse side. It is preferable to keep it teased apart rather than made into solid balls. The meat may be first broiled and then scraped.

The beef meal known as *Mosquera's* is made by digesting lean beef with pineapple juice, which converts the muscular tissue into peptones. After this conversion is complete, the preparation is dried at a proper temperature. It is found to contain about 90 per cent of nutritious matter, of which 77 per cent is proteid and 13 per cent is fat. It has no taste or odor, and can be mixed with equal parts of sugar and cocoa, and taken in hot milk.

Powdered Beef.—One of the most efficient alimentary preparations is beef, desiccated and reduced to a state of powder. This is largely employed by French physicians as a restorative means in phthisis and other wasting diseases. The manner of its preparation is as follows : Lean beef (the round answers well) is chopped into small particles, and is then carefully dried. The mode of drying is an important element in the process. It should be dried on a water-bath or in an oven, the heat of which can be kept within the proper range. It is important not to carry the desiccation too far. When sufficiently dried, the beef is then ground in as fine a powder as an ordinary coffee-mill will make. The time usually occupied in the drying depends on the degree of heat and the size of the pieces, and ranges from ten to twenty hours. If carefully done, the beef loses nothing of its constituents but its water, and preserves its real nutritive qualities. The powder for administration can be mixed with broth, milk, soup, eggnog, and other prepared liquid foods, into which it may be stirred quickly and tossed off. Debove, the author of this forced alimentation, finds that in this way two to four pounds of beef may be given daily, added to other useful foods. It has been shown that the stomach not only receives this large quantity of food materials, but digests them satisfactorily. The author, who has had considerable experience with this method of forced alimentation, is able to speak with confidence as to its nutritive value.

Blood.—The blood of beef carefully desiccated is now furnished in great quantity, and is used internally and by rectal injection as a means of improving nutrition. It is almost the equivalent of dried beef.

Fluid beef preparations are numerous. Beef juice is prepared extemporaneously by broiling quickly over a hot fire and then subjecting small pieces to strong pressure in a lemon-squeezer. *Valentine's* meat juice is prepared by subjecting partly cooked beef to powerful compression in suitable presses. One of the most recent preparations is the beef juice of Wyeth & Brother, and it is said to contain the largest proportion of albumoses. *Johnson's fluid beef* and *Bovinine* are two good representatives of this class.

Eggs.—The following observations refer to the eggs of the domestic chicken. The egg is composed of four distinct parts: the shell; the membranous envelope of the albumen; the white; the *vitellus*, or the yellow. The envelope of the albumen contains nitrogen and sulphur, and phosphate of lime remains after incineration. The white or the albumen contains in 100 parts:

Albumen	12 to 15
Matter not coagulable	5
Water	80

The residue after incineration of the albumen is composed of phosphates and sulphates of lime and magnesia, and alkaline carbonates. The yellow is a phosphorated fatty matter suspended in water by means of an albuminous substance known as *vitellin*. The yellow contains 53·78 parts of water, 17·47 of albumen, and 28·75 of fatty matter. According to Gobley (Fonssagrives, from whom most of these details have been obtained), the yellow has the following chemical constitution:

Water	51·486
Vitellin	15·760
Margarin and olein	21·304
Cholesterin	0·438
Margaric and oleic acids	7·226
Phospho-glyceric acids	1·200
Sal-ammoniac	0·034
Salts	7·299
Extracts	0·400
Ammonia, nitrogenized matters, coloring matter, lactic acid	0·833

Eggs consumed by the sick should be fresh and sound. The average weight is about two ounces avoirdupois. According to Parkes, the following are tests of the freshness and soundness of eggs:

"Fresh eggs are more transparent in the center; old ones at the top. Dissolve one ounce of salt in ten ounces of water: good eggs sink, indifferent swim. Bad eggs will float even in pure water." Fonssagrives recommends the same tests. Eggs coated with beeswax dissolved in warm olive-oil (one third beeswax, two thirds olive-oil) it is said may be preserved for two years.

Eggs raw, or better, whipped, are the most digestible of alimentary substances, and, as their composition indicates, possess a very high degree of nutritive value.

Milk is one of the most important articles of food for the sick, and enters largely into the composition of various diets. It is constituted essentially of four elements—albuminoid, fatty, saccharine, and saline —and therefore contains all the materials necessary for the growth and nutrition of tissues. The nitrogenous constituent is *casein*, an albuminoid substance, but which differs from ordinary albumen in that it is combined with a larger proportion of alkali, and is not coagulable by heat. The fatty element is *butter*, which contains several neutral fats. The composition of butter is not exactly the same in all kinds of milk, the difference being due chiefly to a volatile principle upon which the special taste of each variety depends. The saccharine element is a crystallizable sugar, known as *lactin* or *lactose*, a substance which easily decomposes into lactic acid by a process of fermentation in which the casein plays the part of a ferment. The mineral constituents of milk are, chlorides of sodium and potassium, phosphates of lime, soda, magnesia, and iron. The most important of these is the phosphate of lime. The amount of these salts varies from ·5 to ·8, and rarely exceeds one per cent (Parkes). The French commission, appointed by the Prefect of Police of Paris, reported upon the analysis of milk made in various countries, and concluded that the following figures represent the composition of this fluid when of good quality (Tardieu):

Water	87
Total solids	13

	Casein, extractive matters, and salts.	Butter.	Lactin.
Solids	4·00	4·00	5

The commission fixed the minimum standard of good milk at—

Water	88·50		
Solids	11·50	Casein, extractives, and salts	4·00
		Butter	2·70 to 3·00
		Lactin	4·50

When perfectly fresh, milk is usually neutral in reaction, or it may be a little alkaline. After a short time—especially in summer—it becomes acid by a process of fermentation in which the lactin is converted into lactic acid, and the casein coagulates. The fluid portion is called *whey*, and the semi-solid casein *curds*. By the fermentation of mare's-milk an alcoholic liquor, named *koumiss*, is prepared in Tartary, and has been introduced into medical practice as a remedy for phthisis.

The proportion of cream in good milk ranges from 10 to 15 per cent by volume. By churning, the fat of the cream is collected and is then known as *butter*. This important article of food has the following composition (Fonssagrives):

Margarin	68
Butyrolin	30
Butyrin, caprin, and caproin	2

Butter readily undergoes decomposition—becomes *rancid*—capric and butyric acids separating from the base glycerin. This process is one of fermentation (*butyric*), and is due to the action of a special organism, the growth of which is favored by air, light, and imperfect separation of milk in the process of churning.

After the process of churning, which separates the butter, the resultant liquid, known as *buttermilk*, contains the casein, lactin, and the salts, and is therefore a nutritious article of food.

As the milk of other animals than the cow is sometimes prescribed in medical practice, the comparative chemical constitution of this fluid should be studied. The following table (Pereira) shows at a glance the difference in composition of the milk from several animals:

CONSTITUENTS.	Cow.	Ass.	Goat.	Woman.
Casein:	4·48	1·82	4·02	1·52
Butter	3·13	0·11	3·32	3·55
Lactin	4·77	6·08	5·28	6·50
Salts	0·60	0·34	0·58	0·45
Water	87·02	91·65	86·80	87·98

Whenever fresh and pure milk can be procured, this only should be prescribed for the sick, but in large cities it is not always practicable to obtain it. Under these circumstances "condensed milk" must be used. This preparation is made by evaporation of the water of the milk and the addition of some sugar. It is found in two forms, dependent on the extent to which the abstraction of water is carried: as a granular solid and as a soft semi-solid. The addition of warm water to the condensed milk furnishes a palatable fluid, of the appearance and composition of fresh warm milk.

Fresh milk, boiled and corked up in bottles to exclude the air, will keep for a considerable length of time. To prevent fermentation, some sulphite of lime may be added to it. For temporary preservation of milk in the summer-time, especially when intended for food for infants, a little bicarbonate of soda and sugar may be used.

Cheese contains all the constituents of milk, except the water and some salts and lactin removed by expression. In the preparation of cheese the casein of the milk is coagulated by *rennet*, the butter and a portion of the lactin and salts are entangled in the meshes of the casein, and the mass is subjected to powerful compression. The peculiar flavor and quality of the cheese depend upon the nature and richness of the milk, and upon certain fermentative changes which take place, developing volatile, odorous, and sapid constituents. The following table of the composition of cheese illustrates its nutritive qualities:

Water	36·8
Albuminates	33·5
Fats	24·3
Salts	5·4

it is evidently a concentrated food. The digestibility of cheese depends in part on its freshness, in part on its composition. When fresh and of good quality, it does not ordinarily disagree with the stomach. A small quantity of cheese taken after dessert in some cases assists digestion; but many dyspeptics and persons of weak digestion can not make use of it under any circumstances.

Koumiss.—This is a fluid obtained from mare's-milk by fermentation, and constitutes the principal part of the food of the people inhabiting a portion of Tartary. It contains alcohol, lactic acid, sugar, casein, fat, salts, carbonic acid, and water. In addition to these constituents, ascertainable by chemical analysis, koumiss possesses fragrant compounds, volatile, the product, probably, of the decomposition of the fat and the reaction of the acids on the alcohol, forming ethers. Koumiss of good quality may also be prepared from cow's-milk by the process of fermentation, but, as mare's-milk is more nearly allied to human milk in composition, it is to be preferred in the preparation of this aliment. By variations in the method of preparation, different kinds of koumiss are produced, as, for example, thick koumiss, whey-koumiss, skimmed-koumiss. According to the different stages to which the process of fermentation is carried, there result three degrees of quality, No. 1, No. 2, and No. 3. No. 2 differs from No. 1 in containing more alcohol and carbonic acid, and less sugar and casein. These constituents, especially the carbonic acid, impart a liveliness to the fluid, so that it effervesces like champagne. In No. 3, the fermentation having proceeded further, butyric, succinic, and acetic acids are produced, and the sparkling quality is enhanced.

Koumiss is prepared from milk, by the addition of a ferment—some koumiss obtained from a previous fermentation or dried koumiss. It is allowed to ferment three days at a temperature of from 70° to 80° Fahr. It is then a bluish-white liquid, having a sharp, acidulous taste, and none of the characteristics of ordinary milk. If heated to 100° Fahr., fermentation is definitely arrested. If before being heated it is bottled, products corresponding to 1, 2, and 3, named above, are the result. Allowed to stand after three days' fermentation, it separates into three layers: the inferior, caseous; the middle, an acid water; and the uppermost, a whitish fluid, the best koumiss. The alcoholic strength is of course determined by the stage of fermentation. The koumiss of two days' fermentation is feeble in strength, and hence the product of three days' fermentation is preferable for medicinal use.

The quantity of koumiss administered depends on the condition of the patient. In cases of feeble digestion, this being the only article of food, an ounce every hour will be a sufficient quantity. With increased facility in its digestion and assimilation, from a quart to a gallon a day may be taken. When it is used in connection with other food, a tumblerful may be administered after each meal. It is estimated that each quart of koumiss contains four ounces of solid food.

The tolerance of the stomach to koumiss is remarkable, even in cases of gastralgia. It improves the appetite, and excites the action of the kidneys. The patients experience a pleasing exhilaration, due probably to the combined action of the carbonic acid and the alcohol. Decided intoxication undoubtedly may result from the use of a large quantity by any one unaccustomed to it. It also causes somnolence during the day, and favors sleep at night without leaving any after-headache. Its most important action is the increase of the body nutrition; and hence its utility in the treatment of phthisis, indigestion, and the various cachexiæ. Jagielsky says that he has had patients gain as much as ten pounds a mouth when no other food was taken.

Galazyme and Kefyr.—As the milk of mares and asses can not be procured in quantity in this country, it is necessary, if preparations like koumiss are to be made, to employ for this purpose the milk of cows. Under the name of *galazyme*, a fermented liquor analogous to koumiss was first proposed by Schneep. This is made by the addition to milk of sugar and a ferment, the carbonic acid and alcohol being produced by the fermentation of the cane-sugar, the lactose of the milk remaining unchanged. The formula he gives is as follows:

To every litre (quart) of milk he adds three parts of cane- and five parts of milk-sugar and some brewer's yeast. The mixture is put aside in a suitable temperature until the fermentation has reached the proper point, care being taken to stop the process before reaching the acetic and lactic-acid stage. Deschiens has proposed another formula which has some advantages. He employs the yeast now made for the manufacture of high-grade alcohols, and mixes one drachm of this with two and a half drachms of sugar in some water; this solution is placed in a quart of milk, and the whole is then allowed to proceed to the alcoholic fermentation in the ordinary way. When the process has reached the proper stage, the galazyme is put into strong bottles, the corks fastened in the way the sparkling wines are now inclosed.

A fermented milk analogous to koumiss is prepared in the Caucasus under the name of *kefyr*. The fermentation is set up in the milk by the addition to it of a ferment known as *kefyr*, which is a microbe having peculiar qualities. The microbe ferment of milk—the *oidium lactis*—under appropriate conditions, transforms the lactose or sugar of milk into lactic acid; but kefyr—the *dispora caucasica*—changes it into alcohol and carbonic acid. The difference in composition of milk and kefyr has been shown by chemical analysis to consist in a diminution in the kefyr of the albumen, fat, and sugar, and the addition of lactic alcohol and carbonic acid.

The quantity of alcohol in kefyr and galazyme varies from one half of one per cent to three per cent, and is determined by the extent to which the fermentation has been carried. The amount of carbonic acid, on the presence of which the sparkling character depends, is governed by the stage to which the fermentation has gone at the time of bottling. When completed and bottled, it presents a milky appearance, and on pouring it out from the bottle containing it, effervesces finely, and is covered with an abundant foam. The taste is fresh, slightly acid, and a little pungent, like the ordinary carbonated waters. There is probably no difference between koumiss, galazyme, and kefyr, in respect to their action on digestion and assimilation, and hence the domestic preparation, if properly made, may be substituted for the more expensive imported koumiss.

Preparations of Milk.—Milk is prepared by predigestion with pepsin (*peptonizing*), or with pancreatin (*pancreatinizing*). Milk is peptonized by adding some powdered pepsin, or solution of pepsin, to fresh milk slightly acidulated (hydrochloric acid); or it is pancreatinized by adding pancreatic extract or solution of pancreatin to the fresh milk, with sodium bicarbonate (fifteen grains of the sodium bicarbonate to the pint).

Milk is preserved by the method of *sterilization*, or *Pasteurization.* Milk, heated up to the boiling point—to 212° Fahr.—becomes sterile because all ferments or organisms are inhibited or destroyed at that temperature. To accomplish this result, the milk in bottles or jars is placed in steam chambers, the temperature of which is, of course, at 212° Fahr. Such milk has, however, the taste of boiled milk, and various changes occur in it in consequence of which the casein is less digestible in the juices of the stomach and intestines, the emulsionizing and absorption of the fat is rendered slower, and, according to Leeds, the amylolytic ferment is destroyed. If the milk is allowed to remain too long at 212° Fahr. the lactose is converted in part into caramel, whence the milk assumes a brownish hue.

Pasteurized milk is prepared by raising the temperature of the milk for fifteen to twenty minutes to 160° or 170° Fahr. The bottles containing the milk are immersed for the required period in water at the temperature named. The milk so prepared is but little changed, but it will keep for a day or two only.

Condensed milk has been briefly referred to, but some further details are necessary, since this has become an important food for infants and various invalids. Milk is condensed by depriving it of its water by means of slow and moderate heat *in vacuo.* The varieties of condensed milk are due to differences in the mode of preparation. All the water evaporated, and the residue mixed with a large (60 to 75) percentage of sugar, a dry granular mixture results. The usual form is a soft solid about the consistence of honey, and containing 30 to 45 per cent of sugar. Swiss condensed milk is a mixture of cow's and goat's milk. One form is evaporated by sufficient heat to render it aseptic, and no sugar is required. Put while hot in cans and hermetically sealed it remains fresh for months—even years.

Condensed cream is a product like condensed milk, and is a mixture of milk and cream.

Humanized milk is a preparation of cow's milk made in imitation of human. The preparation of Meigs is a good one; it is as follows:

Cream	2 tablespoonfuls.
Milk	1 tablespoonful.
Lime-water	2 tablespoonfuls.
Water	3 tablespoonfuls.
Milk sugar	½ teaspoonful.

Fish.—A great many varieties of fish are used as foods to which it is necessary to allude in general terms only. Salted fish is not a suitable article of food for the sick: it is difficult of digestion, and possesses but slight nutritive value. Fresh fish, however, properly cooked, is, as a rule, easy of digestion, and furnishes a pabulum of a valuable kind in diseases of certain textures. The following is the composition of fish as compared with beef, according to the analysis of Fr. Schulze:

CONSTITUENTS.	Beef.	Fish.
Fibrin, cellular tissue, nerves, and vessels	15·0	12·0
Albumen	4·3	5·2
Alcoholic extract and salts	1·3	1·0
Aqueous extract and salts	1·6	1·7
Phosphates	traces.	traces.
Fats and loss	1·0	„
Water	77·5	80·1

The commonly-received opinion, that fish is a more highly-phosphorated food than beef, does not receive support in this analysis. White-fish, shad, bass, and fresh mackerel, are more suitable for the sick than cod, salmon, or eels. They should be prepared and eaten as soon as possible after being taken from the water, and should be either broiled or boiled. Only at the time of the ripening of the milt and roe are fish in a suitable condition for the dietary of invalids. At the time of spawning, and immediately after, the flesh of fish is watery and semi-gelatinous.

Oysters rank among the most digestible of foods, and are usually easily borne by the most delicate stomach. According to Fonssagrives the French oyster contains about 12·6 parts of solid matters, consisting of osmazome, chlorides of sodium and magnesium, sulphates of lime and magnesia, fibrin, albumen, and gelatin. They are more easily and quickly digested when eaten raw, or broiled, but stewed is the most common form for use in disease. In cases of great irritability of the stomach, the most easily borne oyster-soup is prepared by the addition of the liquor to boiling milk.

Vegetable.—The most important members of this class of foods are the cereal grains—wheat, rye, corn, rice, buckwheat, oats, and barley. The universality of its consumption and its nutritive value place wheat-bread in the first position as an article of diet. The composition of wheat-flour is as follows:

Water	14·0
Fatty matters	1·2
Gluten	12·8
Albumen	1·8
Dextrin, sugar	7·2
Starch	59·7
Cellulose	1·7
Salts (potash, soda, lime, magnesia, phosphoric acid, etc.)	1·6

In the preparation of wheat-flour, the bran is separated. Important constituents of the wheat are thus removed, as the following analysis of the bran shows:

Water	10·3
Fatty matters	2·82
Gluten	10·84
Albumen	1·64
Dextrin, sugar	5·8
Starch	22·62
Cellulose	43·98
Salts	2·52

The internal envelope of the wheat-grain contains also a ferment, know as cerealin, which has very active properties. As the proportion of bran to flour is as sixteen to eighty, it is obvious that considerable loss accrues in the preparation of superfine flour. Wheat-bread made from superfine flour is easy of digestion, owing to its lightness and sponginess permitting a rapid diffusion of the gastric juices through every part of it. Most of it is also available for nutrition; there is little residuum; hence the constipation which attends its use in large proportion relatively to the other constituents of the diet. When flour is unbolted (bran not separated), an increase of nutritive value is obtained, at the expense, however, of digestibility. A large part of the bran, probably, resists the action of the gastric juice, and hence, irritating the mucous membrane, increases by reflex action the secretions and peristaltic movements.

Whole wheat-grains, under the name of "*cracked wheat*," is frequently prescribed as an article of diet for invalids. It is boiled until the envelope of the grain is burst open, and is eaten with cream and sugar. Obviously such a combination forms a food of great excellence. The special advantage which it possesses, besides its nutritive value, is its laxative action.

Ordinarily, wheat-bread made of superfine flour is to be preferred for the use of invalids. To obviate the constipating action of such bread, and to obtain a laxative effect, various expedients are adopted. Bran, rye, and corn meal, and, in some kinds of bread, molasses, are added to the dough, forming those varieties known as Graham bread, brown bread, and Boston brown bread.

The important quality of lightness is imparted to wheat-bread by thorough incorporation of carbonic-acid gas with the dough. Two processes are employed for this purpose: By the addition of yeast, fermentation takes place at the expense of a portion of the starch, and carbonic acid and alcohol are produced. By mechanical means, carbonic acid obtained from other sources is mixed with the flour. The latter is known as "aërated bread." Obviously, the mechanical process is more economical because there is no loss of flour. It furnishes usually a lighter and drier bread, and is more easily digested. Bread made by the fermentation process is not unfrequently moist and heavy, and sour, because the fermentation has proceeded beyond the alcoholic stage. "French bread" is lighter, drier, and better baked, than ordinary baker's fermented bread. Warm, fresh bread is not suitable for invalids. It can not be so perfectly masticated as older bread, and, not reaching the stomach in a state to permit diffusion through the mass of the gastric juices, lies unchanged for hours.

According to Smith, the ultimate composition of wheat-bread is as follows:

Water	37·0
Starch	47·4
Sugar	3·6
Fat	1·6
Salts	2 3

Macaroni stewed in milk is sometimes prescribed for the sick. Prepared with butter, cheese, and condiments, it is not an appropriate food for invalids. In composition it consists chiefly of gluten, and of course starch—but in less proportion than in bread—and of fat. The cylindrical tubes in which it occurs are formed by passing the paste of flour (gluten) through perforated plates.

Bread requires from three and a half to four hours for complete digestion. Brown bread digests somewhat more slowly.

Barley is but rarely used as food in this country. It is occasionally prescribed for the sick in the form of infusion—a demulcent drink—and is frequently added to soup. It has the following composition (Smith):

Water	15·0
Starch	69·4
Sugar	4·9
Fat	2·4
Salts	2·0
Albuminous substances	6·3

Rice is one of the most digestible of vegetable foods, requiring, when boiled, about one hour. Its nutritive value is not equal to wheat, because it consists chiefly of starch. The following is its proximate constitution:

Water	13·0
Nitrogenous matter	6·3
Starch	79·1
Sugar	0·4
Fat	0·7
Salts	0·5

Rice-water, or decoction of rice, like the corresponding preparation of barley, is used as a demulcent drink in fevers and intestinal disorders. Boiled rice is frequently prescribed as a diet for invalids with weak digestion, and is enriched by the addition of milk and cream, and eggs (rice-pudding).

A comparison of its chemical composition with that of wheat or corn will show that it is by no means equal to them in nutritive value. It is obviously unfitted to sustain life alone, and hence in rice-eating countries it is mixed with fat or other foods supplying principles in which it is deficient.

Corn has the following composition (Letheby, Smith):

Water	14·0
Nitrogenous matter (albumen)	11·0
Starch	64·7
Sugar	0·4
Fat	8·1
Salts	1·7

It is not so readily digested as starch, requiring about three hours. Corn, when green, is prepared for the table by boiling, and is eaten with salt and butter, or milk. If young and tender, and sufficiently cooked, it is a digestible and nutritious food; but, if the grain is too mature, it resists the action of the intestinal juices, and passes unchanged.

The mature grain, deprived of the heart and husk, is known as *hominy.* Thus prepared and thoroughly boiled it is an esteemed article of diet, ranking in nutritive value a little above boiled starch. *Mush* is boiled corn-meal, which may be eaten with milk, and is sometimes fried, but in that form is highly objectionable. Corn-meal is also eaten in the form of bread and cakes. These various preparations of

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corn are liable to cause intestinal disorders, and hence are improper in cases of irritable mucous membrane, and in diarrhœal diseases. For this reason corn-bread is sometimes prescribed in cases of constipation dependent on diminished secretion of the intestinal mucous membrane, and torpor of the muscular layer of the bowel. The starch of corn is not unfrequently prepared for invalids in the form of *blanc-mange.*

Oatmeal corresponds in physical qualities and composition to corn-meal. Its proximate composition, according to Smith, is as follows:

Water	15·0
Nitrogenous matter	12·6
Starch	58·4
Sugar	5·4
Fat	5·6
Salts	3·0

It is not at all generally used as an article of diet in this country. It is prescribed in the form of gruël as a delicate food. Boiled for a long time, the oatmeal swells up and thickens, forming a *blanc-mange*, which may be eaten with milk, or butter, or cream, and sugar and aromatics.

Buckwheat flour is largely consumed in this country, chiefly in the form of breakfast-cakes. As it contains a relatively small proportion of starch, and considerably more fat and salts than wheat flour, it can be eaten by diabetics in the form of light bread, and is said to be preferable to any gluten preparation.

The Potato, next to wheat, is the most important food derived from the vegetable kingdom. Its composition is affected by its source and variety, and by the soil in which it is grown. The specific gravity of the potato affords an index of its nutritive value, for, the heavier, the greater the quantity of starch it contains. For the sick, watery potatoes are unsuitable. When cooked, the tuber should be mealy and dry. The following is the composition of the potato:

Water	75·0
Nitrogenous matter	2·1
Starch	18·8
Sugar	3·2
Fat	0·2
Salts	0·7

According to some authorities, the potato contains free citric acid. The salts are rich in potash. According to Letheby, the composition of the *sweet-potato* is nearly that of the white, the chief difference being the proportion of sugar, which is three times greater than in the latter.

Starch, *Sago*, *Arrowroot*, and *Tapioca*, differ from the preceding vegetable foods in that they contain no nitrogen. They are digested in from one to two hours. They are largely used in the preparation of diets for the sick, but are insufficient in themselves to maintain for any considerable period the vital functions. Hence they are prepared and eaten with sugar, milk, cream, butter, and aromatics.

Turnips, *Parsnips*, *Carrots*, *Onions*, *Asparagus*, *Beets*, *Cauliflower*, *Cabbages*, and *Celery*, are but rarely prescribed for the sick, but enter into certain special plans of diet. According to Smith, the following represents the composition of

Turnips.		Carrots.		Parsnips.	
Water	91·0	Water	83·0	Water	82·0
Sugar	2·1	Sugar	6·1	Sugar	5·8
Nitrogenous matter	1·2	Nitrogenous matter	1·3	Nitrogenous matter	1·1
Fat	—	Fat	0·2	Fat	0·5
Starch	5·1	Starch	8·4	Starch	9·6
Salts	0·6	Salts	1·0	Salts	1·0

Beets differ from the above chiefly in the quantity of sugar. The following is the analysis of Payen :

Water	83·5	Nitrogenous matter	1·5
Sugar	10·5	Pectose, etc.	0·8
Salts and pecten	3·7		

All of the members of this group are deficient in nutritive value, and are besides slow and difficult of digestion, requiring from three to five hours for complete solution.

Ripe fruits, as grapes, apples, pears, peaches, oranges, lemons, etc., possess but little nutritive value, as they contain only about 10 to 15 per cent of solid matters. In composition they are represented by sugar, free acid (tartaric, citric, etc.), nitrogenous matters, and salts. They differ, of course, in the peculiar flavoring matters which give to each fruit its special taste. Dried fruits, as dates, figs, and raisins, are relatively much more nutritive, because they contain a larger percentage of sugar. Under the head of dietetic management of diseased states, some further remarks will be made on the use of the fresh and dried fruits.

SPECIAL PLANS OF DIET.

The food-supplies to the organism may be so managed as to secure very definite therapeutical results. By increasing or diminishing the whole amount of foods ingested, by variations in the quality and character of them, and by the employment of some special and restricted methods of feeding, cures are effected not attainable by medicinal treatment.

Denutrition.—The amount of food necessary for bare subsistence has been pretty accurately determined. During the siege of Paris the daily ration was at one time reduced to less than ten ounces of bread and one ounce of meat daily. Dr. Edward Smith ascertained that the daily amount of food barely sufficient to maintain life among the factory operatives must contain 2·84 ounces of nitrogenous matter, and 19·25 ounces of carbonaceous. Pettenkofer and Voit give, as the necessary amount of food required by an adult when at work, 5·22 ounces of nitrogenous and 22·38 of carbonaceous matter. Letheby furnishes the following table as the result of his investigations on this point :

Daily diet for	Nitrogenous, ozs.	Carbonaceous, ozs.
Idleness	2·67	19·61
Ordinary labor	4·56	29·24
Active labor	5·81	34·97

The ration of the United States soldiers imprisoned at Andersonville consisted of one third pound of bacon and one pound and a quarter of unbolted corn-meal. This amount and quality of food were insufficient to maintain the bodily functions in a healthy state, and hence vast numbers died of scorbutus, diarrhœa and dysentery, and hospital gangrene. From these data we are enabled to form an estimate of the amount and kind of food necessary to maintain life in those cases of disease in which it is desirable to apply the method of denutrition.

Physiological Effects of Insufficient Food.—Intestinal uneasiness, more or less pain, borborygmi, and a feeling of hunger, are among the first symptoms of an insufficient supply of food. The secretions of the intestinal canal diminish, digestion becomes difficult, and constipation results. The respiratory movements are diminished in frequency and volume, and the exhalation of carbonic acid notably declines. According to Dr. Edward Smith, while under an ordinary diet the daily excretion of carbonic acid amounts to thirty-four ounces, under an almost complete abstinence it falls in twenty-four hours to twenty-two ounces. The blood suffers a notable diminution in its amount ; the quantity of water augments, and the number of blood-globules greatly diminishes. Meanwhile the blood loses its plasticity, and a tendency to hæmorrhagic extravasations is developed. The urinary secretion also lessens in amount ; the urea and uric acid diminish, but the hippuric acid rather increases ; the chlorides after some days almost disappear, but the sulphuric and the phosphoric acids persist. As a result of the very obvious decline in the function of assimilation, the temperature of the body falls some degrees below the normal. The functions of the nervous centers undergo a marked derangement. Giddiness, vertigo, hallucinations, ensue, and are coincident with a fatty degeneration of the cells of the gray matter. The subcutaneous fat disappears ; the muscles lose a considerable part of their substance. The muscular substance of the heart diminishes proportionally. The bones do not suffer much loss. The extreme degree of loss attainable with safety is from 40 to 50 per cent of the average weight.

Therapy.—Diminution in the gross amount of aliment and a rearrangement of its constituents are of the first importance in the treatment of *obesity*. The tendency to obesity may be hereditary or acquired. In the former it is cured with difficulty; in the latter a suitable regimen will accomplish much. The fat accumulates under the skin, in the visceral cavities, and in the interstices of organs. Two doctrines have been held by physiologists with regard to the mode of production of fat in the organism: one, that the fat received in the food is simply stored up; the other, that it is also produced by the transformation of some of the other constituents of the food. If the first theory contained the whole truth, it would be necessary only in the treatment of obesity to withdraw from the patient's aliment all fatty substances; but it is found in practice that this is insufficient, and that fat is created out of the starchy and saccharine elements of the food. Hence it is necessary in the treatment of corpulence to interdict not only fats, but the starches and sugar. This was the method of Hippocrates; but it has been revived in our generation by Mr. Banting, and is now usually called *Bantingism*. As a guide to this method of treatment I quote the rules of Mr. Banting:

"For breakfast, at 9 A. M., I take five or six ounces of beef, mutton, kidneys, broiled fish, or cold meat of any kind except pork or veal; a large cup of tea or coffee, without milk or sugar; a little biscuit or one ounce of dry toast; making together six ounces of solid and nine of liquid. For dinner, at 2 P. M., five or six ounces of any fish except salmon, herring, or eels; any meat except pork or veal; any vegetable except potato, parsnip, beet, turnip, or carrot; one ounce of dry toast; fruit out of a pudding not sweetened; any kind of poultry or game, and two or three glasses of good claret, sherry, or madeira—champagne, port, and beer, forbidden; making together ten or twelve ounces solid and ten liquid. For tea, at 6 P. M., two or three ounces of cooked fruit, a rusk or two, and a cup of tea without milk or sugar; making together two to four ounces solid and nine liquid. For supper, at 9 P. M., three or four ounces of meat or fish, similar to dinner, with a glass or two of claret or sherry and water, making together four ounces solid and seven liquid."

Sugar, Mr. Banting finds, is one of the most active of fat-forming foods. His method consists in the avoidance of sugar, fat, and farinaceous substances—in fact, all roots or vegetables grown underground. Although this system was pursued by Mr. Banting with success, it can not always be persisted in without danger. The dietary is wanting in the amount both of carbonaceous and nitrogenous constituents necessary to the healthy action of the organism. Therapeutically it is adapted to the end in view—the denutrition of the body; but it is physiologically considered, unsafe to be long persisted in, because insufficient for the work of the body.

Aneurism.—A low diet, with absolute rest, is of great value in the treatment of internal aneurisms. The diet should be only sufficient to maintain life. The method of Valsalva consisted in such a diet and frequent and free bleedings, with rest. Mr. Tufnell's plan of diet, which has proved very satisfactory in this disease, consists in two ounces of liquid and four ounces of solid food morning and evening, and four ounces of liquids and six ounces of solids at noon, and with this dietary is associated absolute repose in the recumbent posture.

To diminish the Volume of the Fœtus in cases of Dystocia has been suggested by Merriman, Baudelocque, and Moreau, and was successfully practiced in two cases by Depaul. The method consists in free abstraction of blood, and the lowest diet consistent with the existence of life. At the present time the methods of inducing premature labor have been so perfected as to quite take the place of the practice of Depaul.

Syphilis.—It is certainly an eminently rational expedient to relieve the organism of a virus by a continuous and gradual molecular destruction and a renewal of the anatomical elements. Such is the hunger-cure of syphilis, an Arabic method of treating that disease. Very satisfactory results have been attained by this means; but the self-denial and even suffering which it requires render it exceedingly unpopular with patients.

Dry Diet.—This consists in a decided diminution or a temporary total suspension of liquid of all kinds. It is well known that water constitutes about two thirds of the gross weight of the adult body. The quantity of water daily lost from the body has been estimated at about four and a half pounds. Dalton thinks that fifty-two fluid-ounces is the quantity required by a man in full health exercising in the open air. The difference between this and the amount of loss is made up by the water contained in food, especially in the succulent vegetables. Indeed, it is quite possible for the vegetarian, whose diet consists of fruits and vegetables, to receive sufficient water in this way for the purposes of his organism.

Physiological Effects of Dry Diet.—Besides the tormenting sensation of thirst, the food is swallowed with difficulty and the appetite is lost. Absorption of the interstitial fluids takes place, and the volume of the organs undergoes diminution. The subcutaneous veins flatten, and the pulse loses in tension and amplitude; the saliva becomes viscid; the urine reddens and deposits a sediment; constipation ensues, and a rapid emaciation takes place (Fonssagrives).

Therapy.—As the withdrawal or decided diminution of fluid causes rapid absorption of the interstitial water, this method of treatment may be resorted to with advantage in cases of *dropsy*. It has been used with success in dropsical accumulations of the serous cavities, and is adapted to the treatment of *hydrothorax*, *hydrops pericardii*, and *ascites*.

Fonssagrives reports two cases of *diabetes insipidus* (polyuria) decidedly benefited by the dry diet. This method of treatment is indicated in *diabetes mellitus*, in inflammatory affections, and in *fevers*—for it has been shown that the febrile temperature is in proportion to the amount of water furnished the tissues.

Dilatation of the Stomach, besides other appropriate treatment, is benefited by water-free food. That form of dyspepsia and dilatation of the stomach produced by excessive beer-drinking is much improved by abstinence from drinks of all kinds. *The ice-water dyspepsia*, a malady quite common during the summer months of this country, may be entirely relieved by dry diet.

VEGETABLE DIET.—The special indications for the use of vegetable food are reserved for the sections on diet in special diseases. It is necessary, however, to say something here of the *grape-cure*, a method of treatment much in vogue in some parts of France and Germany.

The *grape-cure* consists, according to Carrière, of a diet exclusively of grapes. They are taken many times a day to repletion. It is usual to commence with a pound, and progressively to increase the amount to two, three, six, and eight pounds, a limit which is not exceeded. The first grape-repast, which may be the most abundant, is in the early morning, but not as are the others, eaten in the vineyard. Another is taken at the time of the morning meal (corresponding to our breakfast); the next after the morning walk at the time of the *déjeuner* (noon), consisting of bread and water; another before the usual dinner-hour (evening), and finally before retiring. The treatment is continued during the five or six weeks of the duration of the grape-crop.

The grape-cure is used with success in *plethora of the portal circulation*, *diarrhœa*, *dysentery*, *hæmorrhoids*, and *engorgement of the spleen*. It renders much service in the principal dyscrasiæ, as *scrofula*, *tuberculosis*, and *phthisis*, *gout*, and *cutaneous diseases* (Carrière). The influence of change of air, of new scenery, and of the hygienic rules enforced at these resorts, should not be ignored in an estimate of the value of this method.

The composition of the ripe grape is, according to Smith, as follows:

Soluble.		Insoluble.	
Grape-sugar	13·8	Skins, stones, etc.	2·6
Tartaric acid	1·12	Pectose	·9
Nitrogenous matter	·8	Mineral water	·12
Gum, fat, etc.	·5		
Salts	·36		
Water	79·8		

The quantity of nitrogenous matter is insufficient for the needs of the organism, hence the addition of bread and water to the diet of the grape-cure.

ANIMAL DIET.—The more or less exclusive use of animal food improves the quality of the blood by increasing the number of the red corpuscles. The urine rises in specific gravity, and the urea and uric acid are increased in amount. According to Liebig, force in excess is developed from a diet of animal food, whence a nation of animal feeders must be a nation of hunters, possessing a savage disposition. Those who consume largely of animal food are not fat, but have a high degree of muscular activity. They are tormented by imperious venereal desires, and are irritable in temper.

Therapy.—A diet of animal food is specially indicated and of great utility in *diabetes.* As the vegetables and fruits contain sugar, and starch which is readily transformed into sugar, they are interdicted in this disease. A method of treating *diarrhœa* long practiced in Russia, and popularized by Trousseau, consists in the use of a pulp of raw meat. A bit of fillet of beef is deprived of all fat and aponeurotic fiber, minutely divided, and beaten in a mortar until all traces of fibers have disappeared. It is then pressed through a fine sieve and mixed with sugar, conserve of roses, or suitable aromatics, or seasoned with salt and pepper to the taste. It may be administered in this form with fruit-jelly, or spread on thin pieces of bread. A beefsteak hastily broiled on a hot fire, so as to retain its juices, may be treated by the same method, or the raw beef scraped to a pulp, rejecting the fiber, may be thrown on to a hot skillet for a few seconds to give an odor and appearance of cooked meat. This method, which has been used especially in the treatment of diarrhœal diseases of early life, is equally efficacious in the *chronic diarrhœa* of adults. The chief objection to this mode of alimentation is the great frequency with which tape-worm follows.

In states of debility arising from any cause in which it is necessary to supply an easily-digested nitrogenous aliment, raw beef may be used in this way.

Blood is so rich in the elements of nutrition that its employment as a food in wasting diseases need not excite surprise. Within a few years it has been much used in the treatment of *phthisis*, the patients resorting to the butchers' shambles to quaff the blood as it flows away. On the part of the patients, it is supposed to possess some special curative power; but it is only as a nutrient that its use is justifiable. Besides the unpleasant associations which must necessarily be connected with blood-drinking, there is danger of swallowing parasites. That it improves nutrition, often to a remarkable extent, is undeniable. It must therefore remain a question to be decided by the patient whether he will incur the risk of infection by parasites, to be benefited by drinking a valuable nutrient.

As the serum of the blood contains the most important of the nutritive elements of the blood, the use of this has been proposed in lieu of the latter, administering one ounce three times a day. Blood-serum is said to be an efficient vermifuge. It must be taken fasting.

MILK-DIET.—The numerous and important applications of milk-diet in the treatment of certain forms of disease render it necessary to devote considerable space to the consideration of this subject. Milk is a food already prepared, and therefore needs no intervention of unskillful cooks; it can be obtained everywhere; few patients are disinclined to take it.

Physiological Effects of Milk-Diet.—In the use of a diet for a long time exclusively of milk, great difficulty is often experienced in overcoming the repugnance of the patient. Although as a rule it is taken with readiness at first, after a time it begins to pall upon the appetite, and the greatest resolution is necessary on the part of the patient in order to continue it. A distressing sense of emptiness is experienced at the epigastrium. The mouth becomes pasty, and the tongue is coated with a thick, whitish fur. Constipation, sometimes exceedingly obstinate, occurs, and the stools are hard and of an ochre-yellow color. Occasionally diarrhœa is produced, but this is due to the fact that the milk disagrees and is not digested. The urinary secretion is increased in amount, but this is due simply to an increased flow of water. Although milk contains all the constituents necessary for the nutrition of the body, when it is used as an exclusive article of diet in the case of those accustomed to a full mixed diet, a decided diminution in the weight of the body takes place. After a time, however, the waste ceases, and the weight continues at a uniform level. The interference of a milk-diet with nutrition is more decided when skimmed milk is used—a form in which it is more usually administered in intestinal disorders. The pulse is quickened and the arterial tension lowered; but a fall in the pulse-rate takes place when the body ceases to lose weight. A marked degree of debility is experienced by some persons, so that they are unable to take exercise. In two cases in which I used this method with signal success—chronic eczema, and chronic ulcer of the stomach—the patients, both females, experienced vertigo and faintness, and Mitchell mentions a case in which from the same cause he was compelled to discontinue the milk. Ordinarily, however, nothing more than weakness is experienced.

Therapy.—Pecholier, Carel, Mitchell, and all who have treated of the milk-cure, insist upon the suspension of all other food and drink. The quantity to be taken will vary with the constitutional peculiarities, habits of life, and probably the mental condition of the patient. As milk requires about three hours for its complete digestion, this furnishes a rule for its administration. One gill, or four ounces, every three hours, beginning on rising in the morning, is the rule which I have followed with success. As soon as the patient can take a sufficient quantity, one or two tumblerfuls four times a day may be ordered. From a quart to two quarts is the daily amount which will be taken usually by the patient. It is better administered slightly warm.

In many cases of stomach and intestinal disorders, it is better to give skimmed milk. The milk should stand for twenty-four hours in a cool place, and then all the cream which has risen should be carefully removed. Sometimes, says Pecholier, when crude milk disagrees with or is disgusting to the patient, it may be boiled. The digestion of the milk, says the same authority, when it is poorly borne, may be aided by the addition of lime-water, bicarbonate of soda, and other alkalies. Mitchell has added lime-water for the first few days under the same circumstances, and, in order to overcome the patient's repugnance to the taste, has faintly flavored the milk with a little coffee or caramel; but he prefers to give it alone as soon as possible. My own observation has been, that milk is better borne when given for the first few days with lime-water, in proportion of one fourth of the latter.

For the *nourishment of infants* deprived of their natural food, no substitute is better than cow's-milk diluted with about one third of water and sweetened with sugar, in order more closely to assimilate it in composition to the human milk. This should be given at a temperature of 100° Fahr., and at intervals of three hours. No other food than milk is proper for infants up to the eighth month of life, for their digestive organs are not adapted to the digestion of the farinaceous foods so commonly supplied them. If the milk be rejected, the addition of lime-water may enable the infant to retain and digest it.

In the treatment of disease in the adult with skimmed milk, the time for suspension of the diet depends on several conditions. Carel begins to make additions after two or three weeks; Pecholier when the effects sought for in the treatment are obtained. Mitchell formulates his method as follows: "My own rule, founded on considerable experience, is this: Dating from the time when the patient begins to take milk alone, I wish three weeks to elapse before anything be used save milk. After the first week of the period, I direct that the milk be taken in just as large amount as the person desires, but *not allowing it to fall below a limit which, for me, is determined in each case by his ceasing to lose weight.* Twenty-one days of absolute milk-diet having passed, with such exception as I shall presently mention, I now give a thin slice of stale white bread thrice a day. After another week I allow rice once a day—about two tablespoonfuls—or a little arrow-root, or both, as circumstances may dictate. At the fifth week I give a chop once a day; and, in a day or two, another at breakfast; and after the sixth week I expect to return gradually to a diet which should still consist largely of milk for some months." My own rule has consisted in the gradual addition of other diet after the cessation of symptoms for which the milk-treatment was instituted.

Dr. Stanley S. Cornell, of Ontario, Canada, has favored me with an account of a case of fecal impaction, in which a great quantity of curds accumulated behind the fæces. Such an accident illustrates the necessity of keeping the bowels in good condition during a course of milk diet. One of the Saratoga waters, a little Epsom or Rochelle salts in the early morning, or a little aloes and belladonna at night, will usually suffice. A little black coffee added to the milk may answer.

The milk-cure is especially adapted to the treatment of obstinate stomach affections. It has succeeded admirably in the treatment of *dyspepsia, gastric catarrh, gastralgia, gastric ulcer,* and has procured marked amelioration in cases of scirrhus of the stomach. In *chronic intestinal indigestion,* obstinate and persistent *enteralgia, chronic diarrhœa,* and *dysentery,* it has proved very efficacious.

The treatment of *ascites* by a milk-diet appears to have been of ancient origin, for Hippocrates distinctly refers to it, but the revival of the practice in modern times is due to Chrestian, of Montpellier, who demonstrated the utility of this practice in a number of cases (Fonssagrives). Pecholier and Chairon also report cases of success treated by this method. In cases of ascites the result appears to be due to the profuse alvine and urinary discharges which are caused by the milk-diet in this disease. Pecholier also reports cases of general anasarca due to cardiac disease, much benefited by this treatment. In England, Donkin has issued a monograph on the skim-milk treatment of *albuminuria,* with successful cases. This method has also been extended to *diabetes,* and reports of cures are not wanting.

Eczema, connected with acid indigestion, has been successfully treated by an exclusive skim-milk diet in my hands, and Mitchell reports an analogous case. *Gout* and *gouty affections* have also been much improved, and the diathesis apparently removed, by a persistent use of the milk-cure. Lastly, *aneurism* and *cardiac disease* (irregular and tumultuous action due to valvular lesions) have been benefited by a milk-regimen.

WHEY-CURE.—This mode of treatment is conducted in the mountain health-resorts of Switzerland and Germany, and is usually connected with the grape-cure. As whey contains so little of the nutritious elements of the milk, we may conclude with Lebert that the hygiene and climate of these mountain-resorts do everything for the patients, and if they improve they do so in spite of the whey.

KOUMISS-CURE.—Koumiss differs from whey in containing the nutritive constituents of milk, and from milk itself in the important respect that it is in addition an effervescing alcoholic fluid. Koumiss possesses great value in the treatment of *phthisis, chronic bronchitis, the low stage of fevers, the stage of convalescence from acute diseases,* and in fact in all adynamic states in which the combined effect of alcohol and nutrients may be desirable.

BUTTERMILK-CURE.—To the efforts of Dr. Ballot, of Rotterdam, is due the knowledge we now possess of the value of buttermilk as a food for infants. The relative composition of buttermilk and mother's-milk is given in the following table :

CONSTITUENTS.	Buttermilk.	Mother's-milk.
Casein	43·8	34·3
Milk-sugar	23·6	48 2
Butter	2·0	23·3
Salts	5·6	2·3
Water	921·75	883·6
Total solids	78·25	116·4
Lactic acid	2·75	nil.

It is probably in consequence of the presence of lactic acid, as Dr. Ballot suggests, that buttermilk is easily digested. His manner of preparing the food for infants is as follows : To a pint of buttermilk is added a spoonful of wheat-flour. This is boiled a few minutes. The pap must be thin. To this quantity of buttermilk, after it is boiled, is added half a drachm of sugar. It should have a sweet taste.

In the beginning some teaspoonfuls are given to habituate the infant to the smell and taste, but as soon as possible it should be administered in a nursing-bottle. The temperature should be about 96° Fahr. When the infant acquires a taste for the preparation, it may be given *ad libitum* twice a day.

Buttermilk-cure may be substituted for the milk-cure in cases of *stomach disease*, in which the former has proved so successful, and in cases of *albuminuria* and *diabetes*. In consequence of the large proportion of lactic acid which it contains, buttermilk is more especially indicated in diabetes.

INFANT-FEEDING.—It has already been stated that fresh milk of the cow is the best substitute for the mother's-milk. Some additional observations as to the management of cow's-milk, and as to the substitutes therefor, may, however, be necessary. There can be no doubt that cow's-milk is better than goats' or asses' as a rule, although there are infants who thrive on the two last-named better. In the large cities where it is impossible to procure fresh milk, condensed milk is an efficient substitute. As in the preparation of this the temperature is raised to near the boiling-point of water, it undergoes no change, and can be used when fresh milk is not to be procured, or can not be preserved. Condensed milk is ready for use by mixing it with water in the proportion of one teaspoonful of milk to seven of warm water. When the addition of more water is desirable, it can be added in proper proportion. In the [illegible] experience, children, with few exceptions, do well on condensed milk.

Casein is that constituent of milk which is most likely to disagree with infants. Dilution with water, lime-water, barley-water, etc., is not unfrequently effective in securing the digestion and absorption of the casein; but some infants are unable to digest it at all. Various expedients are resorted to when the casein fails entirely of digestion. Cream diluted with barley-water sometimes succeeds extremely well. The indigestion of the casein of a given specimen of milk may be due to an insufficient quantity of cream; this defect can be obviated by adding it artificially. When the infant is not nourished sufficiently, and yet does not pass undigested casein, the proportion of cream is probably too low. To assist the digestion of casein, Jacobi recommends that a little well-sweetened oatmeal-gruel be given the infant before taking the bottle, or be mixed with the milk. His method of preparing the food is as follows:

"A teaspoonful of either oatmeal or barley is boiled in from three to six ounces of water, with some salt, for twelve or fifteen minutes, the decoction to be quite thin for very young infants, thicker for later months, and then strained through a linen cloth. Infants of four or six months are to have equal parts of this decoction, which ought to be made fresh for every meal; and boiled and skimmed cow's-milk and sugar are to be added. At an early age, the thin decoction; at a later, the milk ought to prevail in the mixture, which ought to be given at a temperature of 80° to 90°; ought to be neutralized, when acid, with a few grains of bicarbonate or carbonate of potassa or soda, and, until infants are eight or ten months old, thin enough to be taken through a nursing-bottle."

Various substitutes have been proposed for cow's-milk; but they are at best constructed on doubtful principles, and vary greatly in composition. Liebig's preparation has had the greatest celebrity, because of the reputation of its inventor, rather than of its intrinsic merit. It is prepared as follows: An ounce of wheaten flour is mixed with ten ounces of milk; it is then boiled for ten minutes, removed from the fire, and allowed to cool to 90° Fahr. An ounce of malt-powder containing fifteen grains of potassium bicarbonate, and two ounces of water, are then stirred into it, and the vessel, covered, stands for an hour and a half at a temperature of 100° Fahr. It is boiled for a few minutes again, and then strained, when it is ready for use. The object of the malt is to transform the starch into glucose.

MILK-JELLY.—Prof. Liebreich recommends the following:

Heat one quart of milk with one pound of sugar, and, when the sugar is dissolved, continue the heat at a boiling temperature for about ten minutes.

Now *cool it well*, and then add, *slowly* stirring, a solution of one ounce of gelatin in a cupful of water. Next add the juice of three or four lemons, and three wineglassfuls of wine or brandy. Set in a cold place. The milk must be quite cold before the other ingredients are added, as it would otherwise curdle.

At the expiration of six months the milk should be given undiluted. An infant's food should always be raised to the temperature of 95° Fahr. Regularity in the time of feeding is of very great importance : for the first six weeks, every two hours, and subsequently, every three hours.

Prof. Frankland proposes the following method of converting cow's milk into a milk having the same composition as human milk. It has much to recommend it, and hence the author invites the attention of his readers to the process of preparation :

"Allow one third of a pint of new milk to stand for twelve hours, remove the cream, and add to it two thirds of a pint of new milk as fresh from the cow as possible. Into the one third of a pint of the blue milk left after the abstraction of the cream, put a piece of rennet about an inch square. Set the vessel in warm water till the milk is fairly curdled, which requires from five to fifteen minutes, the rennet being removed as soon as curdling commences, and put it into an egg-cup for future use, as it can be employed daily for a month or two. Break up the curd thoroughly and separate the whole of the whey, which should be rapidly heated to boiling, when a little more casein separates, and may be removed by straining ; one hundred and ten grains of powdered milk is to be dissolved in this hot whey, and the sweetened fluid added to the two thirds of a pint of new milk."

By the foregoing process the cow's milk loses a portion of its casein and gains in sugar and salts.

Poisonous Milk and Cream.—The importance of milk as an exclusive article of diet, as an addition to ordinary aliments, and as a constituent of various foods, is so great that some reference must be made to the accidents caused by it under certain circumstances. It has long been observed that milk and cream during the hot season, and sometimes cheese at all seasons, brought on extreme gastric disturbance accompanied by profound prostration. The cause of this change in a fluid so innocuous under other circumstances remained unknown until Prof. C. Vaughan, M. D., of the University of Michigan, made the important discovery. He first isolated a *ptomaine* in poisonous cheese. Subsequently his technical skill was invoked to determine the cause of wholesale poisoning from ice-cream, when he was able to confirm his former research by the discovery of the toxic principle, to which he gave the name *tyrotoxicon*. This is a crystallizable principle formed during the course of the butyric fermentation by the action of the microbe of this process. It is a powerful irritant poison, is acrid in taste, and causes a sense of constriction and a persistent after-acridity in the fauces ; sets up an intense gastro-intestinal disturbance, nausea, vomiting, and purging, followed by profound depression of the powers of life. Milk has its disadvantages. Large draughts of cold milk at meals form a heavy curd that may try the stomach severely. There is reason to believe, also, that milk is hurtful to the rheumatic and gouty. As lactic acid results from the fermentation of milk-sugar, or lactose, one of the results of the use of milk may be rheumatic fever—for it is pretty generally held that a variety of lactic acid is the real cause of this disease.

ALIMENTATION IN DISEASES.

Aliment in Acute Inflammations and Fevers.—The febrile state induces serious changes in the constitution of solids and liquids. The interstitial fat disappears from the tissues, which become soft and watery. The muscles grow flabby and pale, and decline in contractile energy. Digestion is feeble, or suspended or abnormal, and the food supplied is either rejected or enters the blood in an imperfectly-prepared state. The blood suffers material alterations; the red corpuscles diminish in number; the fibrin increases, and the products of imperfect tissue-metamorphosis accumulate. The urine is usually scanty and high-colored, and loaded with uric acid and urates. The chlorides more or less diminish in or disappear from the urine, but accumulate in the inflamed tissues. The excretion of phosphates is increased. In the tissues, the seat of organic alterations, rapid but imperfect metamorphosis ensues, and on the one side pathological materials crowd the interstices in the anatomical elements, and on the other the products of waste struggle for elimination. Avoiding further speculation as to the fever-process, it will suffice to state that an enormous increase of the urea-discharge takes place, and that the organs and tissues of the body undergo a granular disintegration, which has been designated "parenchymatous degeneration"; or, as it may be stated, the increased temperature of fever represents an enormous consumption of the nitrogenous elements. The higher the range of temperature, as a rule, the more extensive the parenchymatous degeneration.

In *fevers* and *inflammations* not of the digestive tract, the most useful aliments are milk and beef-juice. These should be given at intervals determined by their rate of digestibility, usually about every three hours. Fresh milk only should be used, and, if the stomach be irritable, it may be diluted with one half to one fourth of lime-water. It has been conclusively demonstrated that fresh milk is the most suitable aliment in *typhoid*, and it may be depended on wholly (Johnson). It is equally applicable as the aliment in *scarlatina*, partly as a nutrient, and partly as a diuretic, for in this disease one of the chief dangers is from arrest of the urinary secretion.

The author is convinced that beef-tea and beef-essence are too exclusively used in the treatment of the fevers and inflammatory diseases. As an aliment, beef-tea is comparatively inferior, and is also difficult of digestion. It is not unusual to see, in cases of typhoid, the beef-tea floating on the peculiar dejections of this disease. It ought, therefore, never to be used as the exclusive aliment in typhoid cases. Another fallacy of a very dangerous kind is current in domestic practice, viz., the belief that beef-tea, which gelatinizes on cooling, is especially rich in nutritive elements. Such beef-tea consists chiefly of gelatin, which has very little value as a nutrient.

FORMULÆ FOR ANIMAL BROTHS.

"*Beef-Tea.*—A pound of lean beef should be freed from fat, tendon, cartilage, bone, and vessels; it must be chopped up fine, and put in a pint of cold water to digest for two hours. It should simmer on the range or stove for three hours, but the temperature should not exceed 160° Fahr. The water lost by evaporation should be made up by the addition of cold water, so that a pint of beef-tea should represent one pound of beef. It should be strained, the beef being carefully expressed. A wineglassful every three hours is a suitable quantity for administration in ordinary acute cases.

"*Mutton-Broth.*—Lean loin of mutton, one pound, exclusive of bone; water, three pints. Boil very gently till tender, throwing in a little salt and onion according to taste. Pour out the broth into a basin, and, when it is cold, skim off all the fat. It can be warmed up as wanted.

"*Chicken-Broth.*—Skin, and chop up small, a small chicken, or half a large fowl, and boil it, bones and all, with a blade of mace, a sprig of parsley, and a crust of bread, in a quart of water, for an hour, skimming it from time to time. Strain it through a coarse colander."

The digestibility of these animal broths is improved by the addition of pepsin and muriatic or lactic acids. Beef-essence, obtained by pounding finely-divided beef in a mortar until the nutritive elements are separated from the fiber, may be administered instead of the broths above described. Essence of this kind may be mixed with sherry or other wines, whisky, or brandy, provided alcoholic stimulants be also indicated. The meat solution which Leube employs so successfully in the treatment of gastric ulcer and other stomach-diseases, is prepared by digesting meat, with muriatic acid and pepsin, in air-tight vessels, at a high temperature. By this process the meat is converted into peptones, ready for absorption.

FORMULÆ FOR DIET-DRINKS.

"*Wine-Whey.*—Put two pints of new milk in a saucepan, and stir it over a clear fire till it is nearly boiling; then add a gill of sherry, and simmer it for a quarter of an hour, skimming off the curd as it rises. Then add a tablespoonful more sherry, and skim again for a few minutes.

"*Flaxseed-Tea.*—Flaxseed, whole, one ounce; white sugar, one ounce; liquorice-root, half an ounce; lemon-juice, four tablespoonfuls. Pour on these materials two pints of boiling water; let them stand in a hot place four hours, and then strain off the liquor.

"*Barley-Water.*—Wash two ounces of pearl-barley with cold water. Then boil it for five minutes in some fresh water, and throw both waters away. Then pour on two quarts of boiling water, and boil it down to a quart. Flavor with thinly-cut lemon-rind, and sugar to the taste; but do not strain unless at the patient's request."

Other foods frequently prescribed for the inflammatory and febrile states are wine-whey and "eggnog," or "egg-flip." To a pint of boiling milk add four ounces of sherry; strain and sweeten the whey to the taste. This is a grateful subacid drink, but slightly nutritive. Eggnog may be prepared as follows: "Scald some new milk by putting it, contained in a jug, into a saucepan of boiling water, *but it must not be allowed to boil.* When quite cold, beat up a fresh egg with a fork in a tumbler with some sugar; beat quite to a froth, add a dessert-spoonful of brandy, and fill up the tumbler with scalded milk." This may be used in alternation with beef-tea, or exclusively in acute inflammatory or febrile affections, but its administration should not usually be more often than every three hours. Milk and egg may be served separately with wine or brandy, as follows: "To one tablespoonful of brandy, or one wineglassful of sherry, in a bowl or cup, add powdered sugar and a very little nutmeg to taste. Warm a breakfast-cup full of new milk and pour it into a spouted jug. Pour the contents from a height over the sugar, wine, etc. *The milk must not boil.*"

"Beat up with a fork an egg till it froths; add a lump of sugar and two tablespoonfuls of water; mix well, pour in a wineglass of sherry, and serve before it gets flat. Half the quantity of brandy may be used instead of sherry."

The foregoing are the most accessible and the most nutritious aliments for the acute stage of fevers and inflammations. They contain the materials necessary to supply the loss taking place in the organism at large, and to repair the damage to tissues in the state of inflammation.

Aliments in Diseases of the Digestive Organs.—In acute and chronic affections of the digestive organs, especially the latter, the skim-milk treatment, already described, possesses the highest value. When the trouble is localized to the stomach and is of an acute character, only the most easily-digested aliments are borne, as, for example, milk and lime-water, barley-water, tamarind-whey, carbonic-acid water, effervescent lemonade, etc. The following formulæ are useful:

"To a tablespoonful of pearl-barley, washed in cold water, add two or three lumps of sugar, the rind of one lemon, and the juice of half a lemon. On these pour a quart of boiling water and let it stand for seven or eight hours. Strain it."

"Boil an ounce of tamarind-pulp with a pint of milk, and strain."

"Squeeze two large lemons, and add a pint of spring or cistern water to the juice and three or four lumps of white sugar. When required for use, pour half of it into a tumbler, and add half a small teaspoonful of bicarbonate of soda; stir and drink while effervescing."

In the *chronic affections of the stomach*, when digestion is feeble, especially of the nitrogenous elements (deficiency of gastric juice), such aliments as boiled rice, tapioca, arrow-root, unfermented bread (aërated bread), and the farinaceous vegetables, are indicated, for these foods are digested chiefly in the small intestine. Cases of acidity and heart-burn, dependent on the fermentation of the starchy and fatty elements of the food, require abstinence from the articles containing them. The acid fruits and vegetables (apples, peaches, tomatoes, etc.) are to be preferred under such circumstances to the farinaceous foods. An acid wine (Rhenish or Catawba), taken at the principal meal, will often correct the acidity derived from the fermentation of starch and fat.

In *intestinal indigestion, summer diarrhœa, and cholera infantum*, it is necessary to supply those foods which undergo solution in the stomach, in compliance with the fundamental therapeutical principle of giving a suffering organ (the intestine) rest. Starches and fats should therefore be withheld. Bread, arrow-root, potato, beans, peas, butter, and other fats, increase the disease, because on reaching the affected organ they are not finally digested, but act as irritants. This result is well seen in the summer diarrhœa of infants. Milk, eggs, animal broths, broiled or raw beefsteak, oysters, white-fish, are suitable aliments under these circumstances. Similar rules obtain in the treatment of *jaundice from catarrh of the gall-ducts* and of *biliary concretions.* The starches and fats are especially active in setting up those local disturbances which result in the production of jaundice by extension of the catarrhal process from the duodenum along the hepatic duct. The use of fat and oil has an immediate result in favoring the crystallization of the cholesterin, or in causing inspissation of the bile.

Cases of *chronic diarrhœa* are sometimes remarkably benefited by a diet of grape-juice, peaches, and such succulent vegetables as tomato, celery, and raw cabbage. It is probable that the cases so benefited are really scorbutic in character. The author has known many obstinate cases of summer diarrhœa of infants to be improved by the addition of ripe peaches to the milk-diet.

A proper regulation of the diet is of great importance in the treatment of *habitual constipation.* This usually depends on deficient secretion, or torpor (a paretic state) of the muscular layer of the intestines. Corn-bread, cracked wheat, oatmeal, bread of unbolted flour, fruits, and such vegetables as green corn, tomatoes, and celery, are indicated. Those troubled with habitual constipation, to a moderate extent, may overcome it by the daily use at dessert of a few almonds and raisins, about six of each. Hæmorrhoids due to congestion of the portal vein, or to constipation, are much benefited by the grape-cure, or a diet of fruits and succulent vegetables.

Aliment in Cachectic States.—To store up fat in the tissues and to increase muscular power, the diet must consist of both nitrogenous and carbonaceous elements. The fats themselves hold the first place as fat-forming foods. Those most frequently employed for this purpose are the fat of meat, butter, olive-oil, cream, and milk. Sugar and saccharine fruits and vegetables rank next in importance as fat-formers. The organism has the power of transforming starch into fat, whence bread, potato, pastry, rice, arrow-root, etc., belong to this class. The malt liquors undoubtedly possess an extraordinary energy in the same direction, hence the use of beer and ale by nursing women; but it is undoubtedly true that milk is better for increasing the production of milk. Less force is lost in the conversion of cow's milk into human milk than in the complex process needed for transforming the nutritive elements of malt liquor. The same fact is true in regard to the relative facility of the appropriation of fatty aliment and of the conversion of saccharine and farinaceous food into fat. It is also true that, for the increase of muscular power, muscular tissues and juices are more easily applied by the organism.

In the *scrofulous*, *mercurial*, *plumbic*, *syphilitic*, and *paludal* cachexiæ, and in *phthisis*, a combination of the flesh and fat forming foods is necessary. The hunger or *denutrition* cure, as already explained, may be applied to the treatment of these cachexiæ, the object being to produce such waste and molecular changes as to cause the elimination of the morbific matters. On the other hand, the object sought to be accomplished in these states of disease and in phthisis, by improving the body nutrition, is to supplant by fresh material the lesions of the anatomical elements.

In *rickets* (*mollities ossium*) it is necessary to supply a food rich in phosphate of lime and other phosphate salts. Oatmeal, bread of unbolted flour, cracked wheat, etc., should be added to the dietary.

Gout, *rheumatism*, and the so-called *uric-acid diathesis*, require a diet composed chiefly of farinaceous vegetables and acid fruits. Animal food and saccharine substances are contraindicated in these disorders.

In no disease is the influence of diet more conspicuous for good or evil than in *diabetes*. I have already alluded to the milk-cure, revived by the Montpellier school and popularized in England by Dr. Donkin. All saccharine substances and fruits and vegetables containing them, and all farinaceous foods the starch of which is easily convertible into dextrine and sugar, are injurious in diabetes. In this prohibition are included bread, potato, beets, beans, peas, sugar, milk, pastry, and sweetmeats of all kinds. Tomatoes, celery, and raw cabbage, are not objectionable. In order to compensate for the loss of bread, the greatest deprivation endured by these diabetics, gluten and almond bread are now prepared. To supply the deficiency in the alimentation of diabetics caused by the withdrawal of the starch elements of the food, fats must be used, as butter, olive and cod-liver oil, fat of meat, cream, etc.

FORMULÆ FOR VARIOUS ARTICLES OF DIET.

Lemonade.—"Put the juice of a lemon to a pint of water, in which an ounce of sugar has been dissolved; then add the white of an egg and froth it up. It may be iced."

Farina-Gruel.—"Stir two tablespoonfuls of farina into a quart of water in a milk saucepan; let this boil until it has grown quite thick; add a pint of milk, a little salt, and let it boil fifteen minutes longer; turn out into a bowl, and sweeten to taste."

Oatmeal-Gruel.—"Put a pint of boiling water into a saucepan; into this stir a couple of tablespoonfuls of oatmeal until quite smooth; let this boil well for ten or fifteen minutes, season with salt, then strain through a strainer, and add a little port wine and sugar, if the patient may have it."

Corn-Meal Milk-Gruel.—"Sweeten a quart of milk, and stir in two tablespoonfuls of corn-meal. This must be carefully cooked, as the meal is apt to scorch, and must be stirred while cooking. A little nutmeg grated on top after it is done makes a pleasant flavor. If the gruel is desired thick, more meal will be needed."

Tapioca Jelly.—"One cup of best tapioca put to soak with a pint of cold water; when soft put in a saucepan with one cup of sugar, the rind and juice of one lemon, a little salt, one pint more water; stir until it boils; turn into a mold; set to cool; add one glass of wine if desired."

Sago.—"Put half an ounce of sago into an enameled saucepan with three quarters of a pint of cold water, and boil gently for an hour and a quarter. Skim when it comes to a boil, and stir frequently. Sweeten with a dessert-spoonful of sifted loaf-sugar. If wine be ordered, two dessert-spoonfuls; and, if brandy, one dessert-spoonful."

Arrow-root.—"Mix two teaspoonfuls of the best arrow-root with half a wineglassful of cold water; add a pint of boiling water; put it into an enameled saucepan, and stir over the fire for three minutes. Sweeten with three teaspoonfuls of sifted loaf-sugar. Add either a wineglassful of white wine, or a tablespoonful of brandy, if permitted."

Arrow-root Milk.—"Mix two teaspoonfuls of arrow-root with a wineglassful of new milk; add half a pint of boiling milk; put it into an enameled saucepan, and stir over the fire for three minutes. Sweeten with a dessert-spoonful of sifted loaf sugar."

Whipped Cream.—"Beat half a pint of fresh double cream with a whisk, add a dessert-spoonful of very finely powdered loaf-sugar, and twenty drops of essence of vanilla or any other flavoring; when firm it is ready for use, but much improved by being on the ice for an hour or two."

Corn Starch Pudding.—"One quart of milk, four tablespoonfuls of corn-starch, four eggs, one tablespoonful of butter, six tablespoonfuls of sugar. Dissolve the corn-starch in a little cold milk, and, having heated the rest of the milk to boiling, stir this in and boil three minutes, stirring all the time. Take from the fire, and while still hot put in the butter. Set away until cold. Beat the eggs very light, whites and yolks separately. Stir the sugar and any flavoring desired in the yolks and then add the beaten whites, and stir in the corn-starch, beating thoroughly to a smooth custard. Turn into a buttered dish and bake half an hour. To be eaten cold."

Beef-Juice.—"Broil quickly some pieces of round or sirloin, of a size to fit in the cavity of a lemon-squeezer. Both sides of the beef should be quickly scorched to prevent the escape of the juices, but the interior should not be fully cooked. As soon as ready, the pieces should be pressed in the lemon-squeezer, previously heated by being dipped in hot water. The juice, as it flows away, should be received into a hot wineglass, and, after being seasoned to the taste with salt and a little Cayenne pepper, eaten while hot. If preferred, the juice may be frozen."

Meat-Tea.—"Put one pound each of beef, mutton, and veal, cut into small pieces, into three pints of cold water. It should simmer for three or four hours, but not boil. When finished, the tea should be carefully strained, and seasoned with salt, and Cayenne pepper if preferred."

Cream-Soup.—"Take one quart of good stock (mutton or veal), cut one onion into quarters, slice three potatoes very thin, and put them into the stock with a small piece of mace; boil gently for an hour; then strain out the onion and mace; the potatoes should, by this time, have dissolved in the stock. Add one pint of milk, mixed with a very little corn-flour to make it about as thick as cream. A little butter improves it. This soup may be made with milk instead of stock, if a little cream is used."

Oatmeal-Soup.—"Put two ounces of oatmeal in a basin, pour over it a pint of cold water, stir it, and let it stand a minute; then pour over it, quickly stirring all the time, a pint of good broth, pour through a fine strainer into a saucepan, taking care that none of the coarse part of the meal goes into the soup. Boil the soup for ten minutes, season and serve."

ARTIFICIAL DIGESTION.

We owe to Dr. Roberts, of Manchester, the introduction of partly digested foods, under the term "peptonized." The formulæ below show the manner in which they are prepared. The liquor pancreaticus mentioned is a solution of the pancreatic juice. This differs from the stomach-juice in that it requires an alkali to give it activity. It can now be obtained of the pharmaceutists or druggists.

Peptonized Milk.—"Fresh milk is diluted with water in the proportion of three parts of milk to one part of water. A pint of this mixture is heated to boiling, and then poured into a covered jug. When it has cooled down to about 140° Fahr., one or two teaspoonfuls of the liquor pancreaticus, and a small pinch of bicarbonate of soda (in solution), are mixed therewith. The jug is then placed under a 'cozy' in a warm situation for one hour. At the end of this time the product is again boiled for a couple of minutes. It can then be used like ordinary milk."

Peptonized Milk-Gruel.—"Half a pint of well-boiled gruel is added, while still boiling hot, to half a pint of cold milk in a covered jug. The mixture will have a temperature of about 125° Fahr. The liquor pancreaticus and the bicarbonate of soda are then added in the same proportion as in the preceding process. The jug is placed under a 'cozy' and kept warm for an hour and a half. The contents are then boiled for a couple of minutes, and the product is ready for use. By this second method the use of the thermometer is dispensed with."

Farinaceous foods are predigested by acting on their starchy constituents with malt or diastase. Of this variety are *Mellin's*, *Hor-*

lick's, and *Benger's*. Mellin's is prepared of coarsely ground flour, to which malt and potash are added. The mixture is then exposed with some water to a moderate temperature, and dextrin and sugar formed. When used, a teaspoonful of the powder is mixed with two ounces of water and a half pint of milk. Horlick's food is similar. Both contain 60 to 70 per cent of carbohydrates in a soluble form, and about 10 per cent of albuminoids. Benger's is also a preparation of wheat flour to which pancreatic extract is added. In preparing for use, a tablespoonful is dissolved in two ounces of cold milk, and to this is added, slowly, a half pint of boiling milk. To prevent further action of the ferment, it is then raised to the boiling point for a few minutes.

Another variety of predigested foods consists of those acted on by diastase and then evaporated with milk and cream. The mode in which these foods are prepared is as follows: Flour of wheat, rye, or other grains, but chiefly wheat, is first made into dough, which is baked, ground, and, mixed with condensed cream or milk, is then dried at a regulated temperature. Malt or diastase added, the starch is converted into maltose and dextrin, and the albuminoids become more soluble.

Nestlé's food, one of the most popular, is prepared from fresh cow's milk which is sterilized, and then wheaten bread crust, previously acted on by dextrin at a proper temperature, is added. Sufficient cane sugar is also added, and the mass is finally dried and pulverized.

Malted milk belongs to this group of predigested aliments. It is sterilized milk mixed with extracts of barley and wheat, and dried *in vacuo*. The starch is converted into dextrin, and the casein is predigested. The powder thus prepared is used by mixing a teaspoonful with a pint of water.

Various objections are now urged against the use of predigested aliments. As a rule they have a bitter and disagreeable taste, and are not relished by the sick. As regards milk—which may be referred to as representative the following changes occur in its composition, according to Leeds: By sterilization at 212° Fahr. milk loses its amylolytic ferment, the casein coagulates less readily by the action of rennet, and the digestibility of the casein is impaired. Of the foods acted on by predigestion, the theory is that they do not require the agency of the stomach, and are already prepared for absorption. Recent experiences render this doubtful. Foods thus prepared do not seem to possess the active nutritive properties of aliments that undergo ordinary digestion. Whenever, therefore, the stomach can dispose of foods in the ordinary way, the method of predigestion should not be employed.

NUTRIENT ENEMATA.—It not unfrequently happens that the stomach will not receive and dispose of nutrient materials, when it becomes necessary to employ nutrient rectal injections. It has been proposed to treat *ulcer of the stomach* by absolute rest of the organ, and the introduction of foods by the rectum. In cases of excessive *irritability of the stomach* the same practice is sometimes necessary. *Œsophagotomy* and *gastrotomy*, as also *wounds of the stomach*, may render the use of nutrient enemata indispensable to save life. It should not be forgotten that the rectum is not an organ of digestion; hence nutrient enemata must contain the materials for artificial digestion. Furthermore, the mucus and fluids of the rectum are alkaline in reaction. To secure rapid osmosis, therefore, the enemata should have an acid reaction. The following formula is suitable for the purpose:

Beef-tea, prepared as before described, four ounces; hydrochloric acid, ten minims; glycerole of pepsin (Scheffer's), two drachms.

If the rectum is irritable, ten to twenty drops of the tincture of opium may be added to the injection. If stimulants are indicated, brandy may also be added. The rectum soon becomes intolerant of injections; hence, the greatest care should be used in practicing them, to avoid sudden distention of the bowel, and frequent introduction of nutrient materials should be avoided. Five times in the twenty-four hours should be the maximum—for artificial digestion is much slower than normal stomach digestion.

Leube recommends the following as a nutrient injection: "Take about five ounces of finely-scraped meat; chop it still finer, add to it one and a half ounce of finely-chopped pancreas free from fat, then add about three ounces of lukewarm water, and stir to the consistence of a thick pulp."

Or the following peptonized formula may be used: "A nutritive enema should be prepared in the usual way—of milk—or of milk with beef-tea or eggs—or of milk-gruel. To half a pint of the warm enema a tablespoonful of the liquor pancreaticus and thirty grains of bicarbonate of soda should be added. The enema can then be administered at once."

Supplementary Rectal Alimentation.—Under this designation, Dr. A. H. Smith, of New York, describes a method of rectal alimentation with defibrinated blood, which seems in a high degree useful. He ascertained that "three to four ounces of blood administered at night would be so completely absorbed in the course of eight or ten hours that no trace of it could be found in the morning evacuation." To retain the blood fluid, it must be defibrinated at the moment it is drawn, which may be done by stirring it with a bundle of twigs as it flows away. In chronic cases three to six ounces may be thrown into the rectum morning and evening; in acute cases every two to three hours. It may be used cold, but it is better to raise it to the temperature of the rectum. Constipation usually results, and in some instances the body exhales a rather fetid odor, and the stools are offensive. Another objection may be urged against this method : sometimes a foul-smelling and tenacious material coats the surface of the mucous membrane and prevents absorption. For this reason, and to promote a favorable disposition of the blood, the bowel should be irrigated with water once or twice a week to clear away any retained or adherent matters. If the rectum is irritable, a little laudanum may be added to each blood-enema.

Forced Alimentation.—A method of involuntary feeding, proposed by Debove, has accomplished so much good that it is necessary to give an account of the mode of procedure. It is entitled *forced alimentation*, because the nutritive material is introduced into the stomach through a flexible tube, which has sufficient capacity to conduct it, and yet is not too large to pass the œsophagus. The tubes now made for the purpose are of non-vulcanized rubber, and have a mark at the outer extremity to indicate the distance to the stomach. The outer end has, also, a funnel-shaped orifice, for the more ready introduction of the nutritive and liquid materials.

The mode of introducing the tube is simple. After being washed out with a warm antiseptic solution, it is lubricated with a little vaseline. The patient lies down on a bed or lounge, the head extended, and the mouth wide open. With the right hand, as if holding a pen, the operator passes the tube into the pharynx, taking care to clear the epiglottis by keeping close to the posterior wall, the patient making successive efforts of deglutition. The stomach is ascertained to be entered by the mark on the tube which comes on a line with the teeth. Retching usually occurs at first, and more or less pain is experienced by the passage of the tube down the œsophagus, but after a few times these troubles cease, and neither pain nor discomfort is felt. Sometimes spasm of the œsophagus occurs, and the onward movement of the tube is arrested ; no violence must be used ; the tube should be slowly drawn back a little, and then by a gentle movement passed on again. If the resistance persists, the attempt should be abandoned for the time being, and another made after an interval. When the tube is duly in the stomach and the retching or nausea is ended, the funnel end is turned up vertically, and the alimentary material is poured slowly down. It sometimes happens during the first trials that portions of the aliment are returned by regurgitation, but this accident does not persist after the few trials necessary to habituate the parts to the procedure.

Debove's powder is the nutritive material now most employed ; it is desiccated fresh beef, reduced to the finest powder. This powder, mixed with water, with *bouillon*, with milk, etc., is readily poured into the stomach, and, in consequence of its extreme tenuity, is easily acted on by the gastric juice. The quantity first given is small, but a rapid increase can be made. From half an ounce to an ounce of the powdered beef is administered on the first day, but this quantity is soon raised to three or four ounces, which is equivalent to four times the amount of fresh beef. At the outset a single dose is given each day, but, as the tolerance increases, two, three, even four administrations are made daily. No other mode of alimentation is attempted, and all the alimentary matters are conveyed by the tube into the stomach.

A remarkable improvement in the condition of the phthisical takes place. In a week to ten days the sweats and diarrhœa cease, the cough and expectoration diminish, and a considerable gain in weight results. A corresponding improvement in the local condition is observed : the râles lessen and may even disappear, and cavities slowly contract. The method can be employed in all forms of phthisis except those accompanied by high fever ; but good results are in proportion to the limited extent of the lesions. When restoration has been effected, the artificial feeding should not be abruptly stopped, but gradually, as the natural manner is slowly substituted.

The method of forced alimentation is not without its inconveniences and dangers. The patient may never acquire the tolerance necessary, and hence the method can not be persevered in. By proceeding slowly and giving a small quantity at a time, gradually the maximum amount may be reached. It is only when anorexia is complete that forced alimentation need be employed—for those who can eat sufficiently in the natural way do not require such an addition to their alimentary resources.

As a therapeutical expedient, properly speaking, forced alimentation has an important place. Associated with the process of stomach irrigation, it may be useful in a high degree in such stomachal disorders as *catarrh*, *ulcer*, *cancer*, *dilatation*, etc.

In the preparation of Debove's powder, the beef is first cut up finely or " minced " by one of the machines now used for that purpose. It is then placed in an oven, dried at a temperature of 110° C. or 230° Fahr., and when completely desiccated is reduced to the finest powder. When completed, the powder has a reddish color, and the taste of roasted meat. When mixed with milk it presents the appearance of chocolate, is very homogeneous, and passes easily through the tube. If the patient is disinclined to submit to the forced process, the powder can be mixed with malt extract, with *bouillon*, with soft-boiled eggs, and will in this form usually be taken readily, and as an aliment is much superior to fresh meat (*Dujardin-Beaumetz*; *Perret*, *Robin*, and others).

It is really doubtful that the forcing method has advantages. When food enters the stomach, the gastric juice is poured out more or less freely whether or no the salivary secretion is correspondingly increased. If the patient can swallow the necessary quantity, it would seem to be entirely indifferent how the nutritive powder got into the stomach. We learn, also, that appetite, hunger, etc., contribute no element to the process, but serve merely as a reminder that the time for taking food has come. It follows, also, from the foregoing considerations, that Debove's powder, or similar aliment, may be administered as a medicament, and that the nutrition will be as favorably affected by it as various morbid states are by an involuntary medication.

BEVERAGES.

Coffee.—*The seed of Caffea Arabica; café*, Fr.; *Kaffee*, Ger.

COMPOSITION.—Coffee contains an alkaloid—caffeine—which is nearly, if not quite, identical with theine, a principle found in tea; a volatile oil; a form of tannic acid; sugar, gum, etc. The tannic acid is that variety known as caffeo-tannic, or caffeic.

The peculiar odor and flavor of roasted coffee are due to the caffeic acid, which is, in part, converted into methylamine; to the aromatic oil; doubtless, also, to the sugar, which is changed into caramel.

PREPARATIONS.—Coffee is never used in the raw state as a beverage. After roasting, it is made into an infusion or decoction. An infusion made at a low temperature, which should not exceed 200° Fahr., is better than a decoction. If the heat be too great, those aromatic constituents which impart to coffee its special aroma, are dissipated. Coffee is now usually prepared by the process of percolation. The best product is obtained by steeping the coffee for some time in hot water. Coffee can be "settled," or clarified, by the addition of some white of egg, or isinglass, or by pouring on from a height some cold water.

Tea.—*The dried leaves of Camellia Thea; thé*, Fr.; *Thee*, Ger.

COMPOSITION.—The constituents of tea are very much the same as those of coffee: theine; an aromatic oil; sugar and gum, and a peculiar form of tannic acid.

PREPARATIONS.—Tea is only used in the form of infusion. The character and quality of the beverage vary greatly with the kind of tea used in the preparation of the infusion. It will suffice to state that green tea is more astringent than the other varieties, partly because it contains more tannin, and partly because it is sophisticated to adapt it to a peculiar taste.

Cocoa.—*Obtained from the seeds of Theobroma Cacao; cocoa*, Fr.; *Kakao*, Ger.

COMPOSITION.—The active principle is theobromine, a substance which resembles the alkaloids of coffee and tea, except that it contains more nitrogen than theine and caffeine. Another important difference between cacao and coffee and tea is the large amount of a peculiar fat (cacao-butter) contained in cocoa. There is also present a minute quantity of a volatile oil, on which depends in part the characteristic aroma.

ACTIONS AND USES.—The use of coffee and tea, or of a corresponding beverage, is almost universal among civilized nations. This fact is supposed to indicate that a need exists in the human constitution which these beverages supply. Such a view is hardly tenable, the highest physical and mental activity not being incompatible with entire abstinence from them. Under some circumstances, however, they are peculiarly grateful; for example, to remove the sense of fatigue and hunger, and to allay the mental unrest produced by fatigue and anxiety.

Coffee has a somewhat laxative action on most persons; on the other hand, tea has astringent properties—especially that variety known as green tea. It has been affirmed and denied that coffee and tea lessen the rate of tissue metamorphosis, and consequently the excretion of urea. If these beverages check waste, they may be considered as indirect nutrients. If used to excess as beverages, they derange the organs of digestion and excite functional disturbances of the nervous system—on the part of the digestive organs: acidity, flatulence, pyrosis, eructations, etc.; on the part of the nervous system: headache, vertigo, tinnitus aurium, and confusion of mind. The evil results of habitual excess are best seen in sewing-women addicted to tea-tippling. It is not uncommon for these women to live upon tea and bread for long periods, resulting in their becoming excessively nervous and dyspeptic. The mucus of the stomach plays the part of a ferment; the bread undergoes the acetic fermentation, and this process is facilitated by the presence of a quantity of a weak astringent solution. Disorders of digestion due to this cause can be removed by withdrawal of the offending beverage. It is not less true that the after-dinner cup of coffee not unfrequently assists the digestion of a too elaborate dinner. Those accustomed to the morning cup of coffee are apt to suffer from headache if deprived of their usual beverage, partly because it hastens the intestinal movements and assists the morning evacuation, and partly because it favors the stomach digestion if not taken in excess.

A cup of strong coffee taken in the early morning is held to be prophylactic against malarial infection. Coffee produces wakefulness, and opposes opium narcosis; hence strong black coffee is one of the means resorted to in the treatment of opium-poisoning.

Cocoa, as already set forth, is more directly nutritious than coffee or tea, and, as it is rich in fatty matters, is much more difficult of digestion, so that many dyspeptics can not use it at all. Cocoa is the most useful beverage in those conditions of the system requiring nutritious aliment, especially in phthisis and similar wasting diseases, and should constitute a part of the diet in these maladies unless it disagrees.

Caffeine as a remedy will be considered in its appropriate place.

Milk.—Regarded from all points of view, milk is the most important beverage. Enough has been said on the subject of milk as a food for invalids; but something additional may be necessary on its dietetic position as an ordinary beverage.

When coffee, tea, and cocoa disagree, milk may be adopted as the ordinary beverage, and usually with great advantage. For breakfast it may be drunk warm. Large draughts of iced milk, according to the American custom, are injurious when drunk at meals; its temperature should not be lower than 60° Fahr. If a sense of weight and uneasiness follow its use, it will be better borne if diluted one fourth to one half with lime-water. If it be desired to improve its nutritive qualities, cream to one fourth or to one half may be added. In the indigestion of the obese, or in the case of those who suffer from hepatic disorders, the milk should be skimmed. A very valuable nutrient, but which is, unfortunately, not very digestible, is chocolate made with milk and cream. Such an aliment is especially suited to invalids with wasting diseases, but who yet retain the power to digest fats.

Some find it impossible to drink milk, because it induces "biliousness." In this case skimmed milk should be used. Generally the indigestion called "biliousness" means errors of diet in other directions, so that regulation of the food suffices to prevent this form of indisposition.

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Water.—*Aqua*, water; *eau*, Fr.; *Wasser*, Ger.; *Aqua destillata*, distilled water—water freed from its organic and inorganic impurities by distillation. This is alone official.

Aqua Fluvialis.—River-water.

Aqua Fontana.—Well or spring water.

Water as a remedial agent, when employed in internal maladies, and as a means of applying heat and cold externally, are the departments of the subject coming within the scope of this article.

PHYSIOLOGICAL EFFECTS OF WATER—INTERNAL.—It need hardly be stated that water is an essential constituent of the tissues.

A certain quantity of water or fluid aliment is necessary to the digestive process. An excessive quantity impairs digestion, by so far diluting the gastric juice as to render it incapable of dissolving the foods. Pepsin—the digestive ferment—is also weakened by too great fluidity of the stomach contents. The free use of cold drinks—ices and iced water—seriously disorders digestion by suspending the action of the pepsin, by diminishing the blood-supply needed by the stomach in its condition of functional activity, and no doubt also by depressing the nerves of the organs of digestion. To this state, induced by the free use of very cold drinks during meals, or during the time of digestion, has been applied the term "*ice-water dyspepsia*," a very common malady in the United States.

A glass of cold water in the morning before breakfast will in many persons cause a satisfactory evacuation of the bowels. The activity of the water is increased by the addition to it of a teaspoonful of common salt.

Although water is essential to the constitution of the fluids and solids of the body, there is no doubt that large and frequent draughts of water may prove injurious by too great increase in the fluidity of the blood, and a consequent damage to the red corpuscles.

The free use of water promotes nutritive changes, and causes in some subjects a decided increase in the formation and deposition of fat. The presence of water is essential, of course, to the metamorphosis of tissue, whether physiological or pathological. The efficacy of mineral waters is in part due to the quantity of water taken, besides the mineral constituents. Water may be taken with the view to cause increased excretion of certain substances. As a large part of that taken passes out by the kidneys, the functional activity of these organs is promoted by free drinking. With the water also passes out an increased amount of urea, chloride of sodium, and phosphoric acid, the product of the more rapid tissue-changes which ensue. The increased elimination of chloride of sodium does not continue, however.

Water is also excreted by the skin, and free water-drinking promotes the cutaneous transpiration, especially when its action is aided by external warmth. The vapor of water also passes out abundantly in the breath.

Physiological Effects of Water—External.—The influence of temperature must necessarily be considered in connection with the effects of water when applied externally.

Effects of Cold Water.—When an extremity—for example, the hand—is immersed in cold water, the temperature of the other hand also falls. Cold water abstracts the heat of the body, at least of its superficial surface, and affects the condition of the internal organs through the nervous system. It is through an influence transmitted from the peripheral distribution of the nerves of the hand to the center, and thence reflected to corresponding anatomical nervous connections on the other side, that the fall of temperature in the one hand is due when the other hand is immersed in water. We have a right to assume, therefore, that, when cold water is applied to the whole surface of the body, changes of temperature take place within. Indeed, it has been shown experimentally by Brown-Séquard, that ice applied to the lumbar region causes a contraction of the arterioles of the kidneys, and consequent diminished blood-supply to these organs.

When a cold bath is entered, a marked sense of chilliness is experienced, the skin becomes pale and is roughened by the erection of the hair-follicles (*cutis anserina*), the lips are blue, the breath has a spasmodic and catching character, and the pulse is quickened. The temperature of the surface is lowered, for the blood accumulates in internal organs, and the nerves of the skin are depressed. To the change in the conditions of the blood-supply, and the impression of the cold on the peripheral expansion of the nervous system, are due the coldness of the surface, the sobbing respiration, and the feeling of discomfort and depression. If the temperature of the water be not too low, and if the bodily vigor be sufficient to withstand the shock, the condition known as " reaction " speedily ensues. The coldness and depression are succeeded by warmth and a feeling of exhilaration ; the pulse quickens, and the respiration becomes easy and unembarrassed ; and the muscular strength is increased. If, however, the body be immersed for too long a period, the condition of reaction is supplanted by coldness, depression, weakened pulse, and muscular debility. This result is largely due to the continuous abstraction of heat, to the accumulation of blood in the great venous trunks, and the consequent interference with the metamorphosis of tissue. If healthy reaction comes on after bathing, the effects are those to which we apply the term *tonic*. The circulation is invigorated, tissue-changes take place more rapidly, and the products of increased tissue-metamorphosis are found in the urine. With the increased activity of the function of assimilation, the appetite and digestive power are improved, and the body gains in weight.

EFFECTS OF WARM WATER.—The degree of effect which is produced by the immersion of the body in warm water is influenced by the temperature; but the quality of the effect is the same at all degrees from tepid to hot. The sense of warmth is at first grateful to the feelings; the skin becomes red from the increased activity of its vessels; the pulse quickens in beats, but diminishes in tension; the respiration is more frequent; præcordial oppression is experienced; an unpleasant sense of distention is felt in the head, and giddiness, faintness, and muscular languor, finally, are produced, if immersion be prolonged or the temperature be too high. The pulmonary and cutaneous transpiration are increased by the warm bath; the temperature of the body rises, and a condition is established by a hot bath, similar to the febrile state. Rapid disintegration of tissue ensues, the waste products escape chiefly by the skin and pulmonary mucous membrane, and decided loss of weight results.

MODES OF APPLYING WATER.—The water of a *cold bath* should have a temperature of 40° to 60° Fahr. If employed for its tonic action, the patient should not remain in it longer than the period of complete reaction. The *tepid bath* has a temperature of from 85° to 95°, the *warm bath* from 95° to 100° Fahr., and the *hot bath* from 100° to 106° Fahr. The duration of the stay in these will depend on the purpose to be accomplished, whether mere excitation of the circulation in the skin, diaphoresis, or muscular relaxation. In directing the warm and hot baths, it should not be forgotten that a diseased state of the cerebral arteries is a contraindication to their use.

The vapor of water in the form of the *Russian bath*, *steam-bath*, or *warm* or *hot wet-packing*, may be used to accomplish the same objects as those obtained by the warm or hot bath. Without entering unduly into the details, it will suffice to state that the Russian bath consists in the exposure of the body in suitable apartments to the vapor of hot water, at a temperature gradually increased from 95° to 110° Fahr. The bath should not, under ordinary circumstances, exceed fifteen minutes in duration. In order to overcome the relaxing and debilitating effects of the bath, the patient should either enter a cold bath or have cold water dashed over his body. This expedient, conjoined with friction of the surface, increases materially the good effects of the Russian bath. In the absence of special arrangements for giving the Russian bath, simple means will suffice. The patient may sit upon a low stool with a blanket pinned about his neck, and under this the vapor of water may be conducted. Or, if confined to bed, the patient may be placed on a gum-cloth, and the blanket may be elevated above him by hoops, arranged transversely, under which the vapor of water may be conveyed from an ordinary tea-kettle. Fresh lime is sometimes used to generate hot vapor. The patient is placed on a low stool and surrounded by a blanket. Some pieces of *freshly burned* lime are then dropped into a vessel of water placed under the blanket. The slacking of the lime causes great heat, and the consequent generation of a considerable quantity of watery vapor, which also carries up with it minute particles of lime. This proceeding is said to be especially efficacious in membranous croup and diphtheria.

Enveloping the body in cloths wrung out in hot water, or wrapping in a sheet which has been wrung out in hot water, and then covering with blankets, is a mode of applying moist heat which may be advantageously used. To various parts of the body, under the designation of "fomentations," warm and hot water applications are constantly used in domestic practice.

The Wet-Pack.—This efficient means of producing the good effects of cold-water applications consists in wrapping the body in a linen sheet wrung out in cold water. The appliances are these: An ordinary single bedstead; a hard mattress covered with several thicknesses of blankets or comforters; a linen sheet. The sheet is dipped in cold water, and, when thoroughly wrung out, is laid smoothly on the bed. The patient reclines on the sheet, his head supported by a pillow. One side of the sheet at a time is then drawn over the patient's body and neatly tucked under the opposite side, the feet and legs being lifted up and the sheet made to entirely envelop them. Some blankets or comforters are now closely applied around the body of the patient. There is at first experienced a disagreeable sense of chilliness and discomfort, which is soon succeeded by a delightful glow. When reaction is fully established, the wet-pack should be removed, and the body be well rubbed with dry towels. The duration of this application should be from fifteen minutes to an hour. When active diaphoresis is the object to be accomplished, the patient must be well enveloped in blankets, and continue in the bath for the longest period mentioned above.

The Rubbing Wet-Pack.—This is a convenient mode of taking the morning bath as a hygienic measure, and also of procuring more speedily some of the good effects of the wet-pack as applied above. It consists in enveloping the body with a sheet dipped in cold water, and rubbing vigorously with the sheet to induce reaction quickly. The patient stands up during the application, and an attendant rubs those parts inaccessible to the patient. When the sheet is removed the skin is dried by the vigorous application of coarse towels, and the patient immediately puts on his clothing.

When it is not advisable to apply the wet-pack to the whole body, or when local diseases require limited application of the wet-pack, the sheet may be wrapped around the trunk only, or be confined to the region of the affected organ. In cases of extreme debility, or in very susceptible persons, the sheet may for the first applications be wrung out in tepid water, and subsequently the temperature of the water be lowered to that of the air (40° to 70° Fahr.).

The Douche.—This consists in the impact against the body of a column of water from a height. No greater height than ten feet, and a column not larger than four inches, will be proper or safe under any circumstances. A hose attached to a water-pipe, the supply being regulated by a stopcock, is a convenient mode of using the douche. In domestic practice a large pitcher or water-bucket, if provided with a suitable spout, may be utilized for this purpose. The douche may be either cold, tepid, or hot; it may have a direction descending, ascending, vertical, horizontal, or oblique; and the effect may be regulated by the height from which the water is projected, the size of the stream, and the force with which it is thrown against the part. As the effect of the douche is very great when the water is cold, when the volume of the stream is large, and when it is thrown with force, it is obvious that care must be used in directing it against the head, the chest, and the abdomen. As a rule, it is too violent a measure to be employed in weak and susceptible subjects about the trunk, but it may be used freely, of course, on the extremities.

The Hip or Sitz Bath.—As regards temperature, this bath may be cold, tepid, warm, or hot, according to the indications requiring it. The apparatus for administering it consists of a tin or wooden tub of sufficient capacity to contain water enough to cover the hips and lower part of the abdomen when the patient sits down in it. The tub should have a raised back to support the patient, and should be sufficiently elevated above the floor, so that the feet may rest comfortably when the patient sits down in the water. In the absence of a special arrangement of this kind, any ordinary washing-tub will suffice. The duration of the hip or sitz bath will be from five to thirty minutes.

Besides these, various local baths, cold, warm, or hot, under various designations, are used in medical practice, e. g., foot, hand, elbow, and head bath. The effects of these differ in no wise from the baths already described, except in degree.

THERAPY.—The applications of water in the treatment of disease are numerous and important.

In *tonsillitis*, *diphtheria*, and *croup*, ice held in the mouth and allowed to come in contact with the fauces is extremely serviceable. The wet-pack to the neck gives great relief in the same diseases. The mode of applying it is as follows: A napkin is wrung out in iced or cold water and wrapped around the neck; and over this is put a dry towel or napkin to prevent evaporation, and also the wetting of the patient's clothes. In *spasmodic croup* (*laryngismus stridulus*) the application of iced water in this way will frequently very quickly stop the crowing inspiration and allay the distress of breathing. A cold douche will effect the same result, but this is an unnecessarily harsh remedy in these cases. Sometimes hot applications are more efficacious, when the napkin or towel may be wrung out in water as hot as can be borne. Cold affusion, or, better, sponging of the body with cold water, is an excellent means of preventing *laryngismus stridulus* when it arises from cold.

Habitual constipation may sometimes be overcome by a glass of cold water taken before breakfast. *Hæmorrhoids* that bleed, especially when attended by constipation, are improved by a daily rectal injection of cold water. When cold or warm water injections are used to cause an evacuation, it must be remembered that, usually in adults, a large amount of water is necessary—about one quart. A small quantity of iced water may be effective, for in this case the impression of the cold on the nerves of the rectum excites a reflex action of the whole intestinal canal.

Pure water or distilled water is an effective diuretic, especially adapted to the relief of *acute desquamative nephritis*. The action consists in free discharge of the surplus water by the kidneys, and the consequent washing out of the tubules obstructed by the cast-off epithelium and tube-casts. Large draughts of water, as has already been stated, carry out from the kidneys the products of retrograde metamorphosis, and hence the action is diuretic in the widest sense. The efficiency of many infusions, decoctions, and ptisans, employed in dropsies, is largely due to the amount of water ingested. The internal use of water in kidney-diseases may be supplemented by hot fomentations to the lumbar region. (See article DIGITALIS.) As irritation of the skin of the back has been shown experimentally to influence the caliber of the renal arterioles, there is sufficient warrant for the practice of applying these fomentations to the lumbar region, when the functional activity of the kidneys is insufficient.

When renal disease is so far advanced that the *elimination of urea is seriously hindered*, and *stupor*, *somnolence*, *muscular twitchings*, and even *convulsions* occur, great relief is obtained by exciting free action of the skin by means of the vapor-bath or hot wet-pack, the patient being well enveloped in blankets to favor powerful diaphoresis. The Turkish bath is very serviceable to restore the suppleness of joints and muscles after an attack of *acute rheumatism*, and *chronic muscular rheumatism* is benefited by the same means. No permanent good result can be expected from these baths in chronic rheumatic arthritis.

As a means of causing elimination of *mineral poisons*, baths are useful. *Lead, mercurial,* and *paludal cachexiæ,* are relieved by the Turkish bath and the wet-pack, and, although these means are insufficient of themselves to effect a cure, they aid very materially the action of other remedies. Increased metamorphosis of tissue and increased excretion are, it will be remembered, constant effects of these baths. If the wet-packing be used, free diaphoresis should be encouraged, by abundant covering and by large draughts of water.

One of the most important recent improvements in therapeutics is the treatment of *fevers* by cold baths. This is an old expedient, it is true, but it is only within a few years that the treatment of fevers by baths has been placed within the domain of strictly scientific investigation. Various means of applying water in fevers have been resorted to—cold affusion, cold baths, cold wet-pack, ice-bags, etc. Cold affusion consists simply in dashing successive buckets of water over the patient, stripped and lying on a mattress protected by a gum-cloth. The applications are continued until the temperature is reduced. This is a crude method, and wears an aspect of harshness which may prevent its efficient use in private practice. The cold bath is more serviceable, and is free from the objectionable features of cold affusion. As practiced according to the method of Ziemssen, it is grateful to the patient, produces no shock, and exerts a powerful influence over the temperature. The fever-patient is put into a bath about the normal temperature of the body (98° Fahr.), and the water is cooled, by the addition of ice, to 80° Fahr., to 60° Fahr., or even to 40° Fahr., according to the effect produced on the temperature, which, for this purpose, should be taken in the rectum. When a positive reduction of the fever-heat has occurred, at the expiration of five minutes to half an hour usually, or longer if necessary, the patient should be wiped dry, placed in bed, and covered with blankets. The bath may be used, according to the nature of the case, from two to six times each day, but less frequently if the duration be longer than a half-hour. The appliances for administering baths to fever-patients are: A strong sheet for lifting the patient from the bed into the bath-tub; a bath-tub provided with an exit-pipe for drawing off the surplus water; a thermometer for ascertaining the temperature of the bath, and a clinical thermometer for noting the variations of temperature of the patient. Hospitals should be provided with such arrangements as have been made at the London Hospital for the use of baths in fever. These consist of a small ward with two beds; a bath-tub supplied with hot and cold water; a tank, with which the cold-water pipe communicates, in which ice may be put if necessary; and a large waste-pipe for disposing quickly of the surplus water.

In the absence of suitable bath appliances, the temperature of fever-patients may be reduced by simpler methods. Iced water may be injected into the rectum frequently ; cloths dipped in iced water may be applied to the trunk, and Chapman's ice-bags may be put to the spine. More suitable than these methods is the wet-packing. Although the wet-packing is not so effective as the bath, it is a very powerful means of reducing fever-heat, and it has the merit of simplicity of application, so that in every household it may be used if necessary. The patient may be put into the wet-pack several times each day, according to the state of the temperature, and may remain in it from five minutes to an hour.

If, after the application of water by any of the modes above mentioned, the circulation becomes feeble, the extremities cold, and the lips blue, stimulants should be administered and bottles of hot water applied to the feet. The good effects of baths are these : the temperature declines, the pulse falls and becomes soft and compressible, the skin grows moist, and the patient feels refreshed. The repetition of the bath or of the application of cold water will be determined by the rise of temperature, and of the pulse. Some practitioners employ them regularly, as, for example, Von Ziemssen and Immerman, who administer them at 6 A. M., 1 to 3 P. M., and 7 P. M.; but others—and this the author thinks the better plan—give them more or less frequently according to the range of temperature. Not only is the mortality of typhoid greatly less under hydrotherapy than under any other method of treatment, but the complications which belong to it—except hæmorrhage—occur less frequently.

The most conspicuous triumph of the water-treatment of the pyrexial state is seen in the management of *hyperpyrexia*, a condition of things in which a sudden and rapid rise of temperature takes place, the range being in extreme cases from 105° to 112° Fahr. It is now perfectly well known that any temperature above 108° Fahr. is almost necessarily a fatal sign. This condition of hyperpyrexia occurs sometimes in *acute rheumatism*, *delirium tremens*, *fevers*, etc., and has heretofore not been amenable to treatment. A fatal result in these cases may be averted by cold baths, the temperature of the bath being rapidly reduced from 96° to about 60° Fahr., by the addition of ice. It is sometimes necessary in these cases to prolong the stay in the bath to two or three hours, but it must not be forgotten that no absolute rule can be made, the state of the patient's pulse, respiration, and temperature being the guide not only as to the temperature of the bath, but the duration of the stay in it.

Typho-malarial fever is best treated by the same means ; but malarial fevers are, of course, so unquestionably remediable by quinine that any other treatment is a waste of time. Baths are, however, extremely grateful in the pyrexial stage of malarial fevers.

Cold baths are of equal utility in *scarlatina.* In mild and uncomplicated cases of this disease, no remedies are required, and simple sponging of the body, followed by inunctions of oil, is all that is required. When, however, the temperature rises to 104°, 105°, 106° Fahr., and higher, and there is delirium or stupor, the rash being dark and indistinct, and the urine scanty, the cold wet-pack will often render most signal service. The rash will reappear and become vividly red ; the pulse, respiration, and temperature, will decline. The cold wet-pack to the neck, and frequent gargling of the throat with warm water, relieve the sore-throat, and are really more effective than the caustic applications so commonly resorted to. When the urine becomes scanty and highly albuminous, hot fomentations to the lumbar region, with or without addition of medicaments, are often very serviceable. The vapor-bath, or the warm wet-packing, by determining free diaphoresis, relieves the brain when convulsions are threatened, or have actually occurred, from uræmia.

Other eruptive diseases, *measles, small-pox, cerebro-spinal meningitis,* are advantageously treated in the same way.

Constitutional syphilis is very much ameliorated, and the cure by specific treatment hastened, by a course of Turkish baths, or wet-packing. Three baths should be taken each week. If the wet-packing be used, the patient should remain in it until free diaphoresis is produced.

The wet-packing is very efficacious in *acute rheumatism,* but the prejudices of the patient, and of the patient's friends, often interfere to prevent its use. If there be much pain and soreness, the front of the body may be packed, and the inflamed joints may be separately swathed, but, whenever practicable, the packing should include the whole body. A vapor-bath is often very serviceable. A vinegar vapor-bath has been used, it is said, with great advantage. This application may be readily made in the following way : Some bricks are previously heated ; the bedclothes are elevated above the patient by hoops transversely placed ; and vinegar is poured over the heated bricks, which have been laid under the bedclothes. The perspiration which follows these baths should be wiped off, the skin quickly sponged with tepid water, and then dried with a soft towel. Great relief is experienced from these applications ; the joints are less tender, the fever declines, and the acid perspirations are diminished. *Chronic rheumatism,* if chiefly muscular, and if changes have not occurred in the joints, which are simply stiff, and *chronic gout,* are much benefited by the Turkish bath.

In *acute cerebral congestion,* the cold douche may be applied to the head, while the feet are immersed in warm water. A piece of ice, held against the nape of the neck, acts powerfully in the same way. The alternate application of ice and hot water is often more effective than ice alone. The author has seen these alternate applications of ice and hot water have an excellent effect in the stupor of *opium narcosis*, of *uræmia*, and in *carbonic-acid poisoning*, occurring under various conditions.

In *inflammatory affections* of the meninges, and in *meningeal hæmorrhage*, a bag or bladder of pounded ice has the sanction of universal use. The author believes that these applications are often made without due discrimination in *cerebral hæmorrhage* and other allied states. When the face is pale, the surface cool, and the circulation depressed, cold applications to the head are harmful. Ice to the head, and frictions of the surface with ice, are very serviceable in *sunstroke* or *thermic fever*, when the surface is hot, the pupils contracted, and the pulse full and bounding. The cold wet-packing gives great relief under the same circumstances, but, when the symptoms of depression exist, these cold applications are hazardous. Usually, however, in *thermic fever*, the range of temperature is very high, and the most important indication is to abstract the heat, which can be best accomplished by application of ice or the cold wet-pack, or the cold bath. The results of the practice are in accordance with this theory, for these applications have been most successful in restoring patients in imminent danger of death. When, in *delirium tremens*, the head is hot, the conjunctivæ injected, the face flushed, and the pulse strong, an ice-bag to the head, or cold affusion, or a mild douche, will assist in quieting the patient, and favor the production of sleep; but these measures will do mischief when considerable depression of the bodily powers exists, and they are of doubtful utility in any case affording evidences of atheroma of the cerebral arteries, or of cardiac disease. Cold affusion to the head and spine, and cold baths, are among the most important means of relief in *chorea*. *Wakefulness* in children and adults may be often overcome, and quiet sleep insured, by a tepid bath taken just before retiring; but, when the head is hot, the eyes brilliant, and the circulation active, cold should be applied to the head, while the body is immersed in the tepid bath.

The shower-bath, the douche, and cold affusion, were formerly much used to calm the violence of *acute mania* and *maniacal delirium*. The great depression of the powers of life which the douche and the shower-bath have caused in some cases, and the fatal results which have occurred during their administration, have led to their disuse by many alienist physicians. By others, they are held to be extremely serviceable in appropriate cases. Bucknill and Tuke advise the occasional use of the shower-bath in the *excitement* of *intercurrent mania* and *monomania*, and a daily shower-bath in *melancholia*. They advise, further, that the shower-bath should, in the first-named group of cases, be used no longer than three minutes, and in *melancholia* from fifteen to thirty seconds, the patient being dried while standing in a pan of hot water. The same authors prescribe a warm bath of thirty minutes, at 95° Fahr., for the excitement and sleeplessness of various forms of insanity, and they affirm that its "tranquillizing effect is often wonderful." The simultaneous use of cold affusion to the head and the warm bath has been warmly advocated by M. Brierre de Boismont, and is decidedly approved by Bucknill and Tuke, who advise that the duration of the bath should not exceed one hour. The wet-pack is an exceedingly valuable remedy in the excitement of *acute mania*, but this measure should not be allowed to degenerate into a means of restraint merely. It should be applied in the mode already described, and the patient should continue in it until free diaphoresis is established.

In *infantile convulsions* great benefit is derived from the general warm bath combined with cold affusion, or an ice-bag, to the head. *Hysterical convulsions* are quickly relieved in the same way, and the *hysterical state* is much improved by a daily shower-bath.

Water, cold and warm, in the state of vapor, as ice, has been largely applied in the treatment of *tetanus* and *hydrophobia*, but without good results beyond the merest temporary assuagement of the patient's sufferings.

Lesions of the spinal meninges and of the cord, corresponding pathologically to those of the brain, are remediable by similar means as respects hydrotherapy. The author has seen remarkable improvement follow a hot douche to the spine in a case of paraplegia of syphilitic origin. Erb reports remarkable curative results from the use of the "rubbing wet-pack" in *chronic myelitis*. He advises the use of merely tepid water, and opposes the application of the extremes of temperature, whether hot or cold. The *backache* so common in women, and frequently due to anæmia of the cord, may be much relieved by a sponge dipped in hot water and passed over the spine. The hot douche to the spine is often more decidedly serviceable in these distressing cases.

Alterations of sensibility, *analgesia*, *anæsthesia*, *hyperalgesia*, *hyperæsthesia*, are often relieved by hydrotherapy—by the wet-pack, by ice, by local hot and cold affusion. Neuralgic affections, especially *sciatica*, are benefited greatly by the wet-pack. Paralyzed parts that have become cold and that waste, and that are undergoing other nutritive changes, are improved in condition by douches, by wet-packing, and other methods of the water-cure.

In *inflammatory affections within the chest*, wet-packing is very useful. As a rule, a hot wet-pack gives more relief than a cold one, but the feelings of the patient are a proper guide. In *acute pleuritis* a cold wet-pack applied to the side unquestionably diminishes the pain, and no doubt relieves the inflammation. In *pneumonia* remarkable results have been obtained by the cold bath, as well as by topical applications to the chest. Jürgensen has especially done much to establish this practice on a sure basis, and Dr. Thomas J. Mays, of Philadelphia, has published statistical evidence of a most favorable character. The mode of procedure is the same as in hyperpyrexia and in fevers. The patient is immersed in tepid water, and cold water is added to reduce the temperature of the bath to 60° Fahr. The stay in the water is determined by the effect on the body heat, the condition of the heart, and the respiration. The reduction of the febrile heat is coincident with a decline in the local inflammation. When the organs within the chest are inflamed, it is good practice to wrap the whole chest tightly in a pack to limit the motion of the chest-walls. The method of proceeding is as follows: Wring out in cold or hot water a large towel, fold it and place over the affected side or part; have in readiness a bandage or long towel sufficient to encircle the chest, and confine the wet-pack by pinning as tightly as possible around the chest the bandage or towel. Spongiopiline is an excellent material for making these hot or cold applications. The same expedients—the application of cold and the tight bandage—are of great utility in *pulmonary hæmorrhage*, but a more decided effect, by means of ice-bags to the chest and back, may be procured in this condition of things.

Cold and hot applications have unquestionable value in *inflammatory affections of the abdominal organs.* The author has seen excellent results from the application of an *ice-bag* over the swelling in cases of *typhlitis* and *perityphlitis*. *Peritonitis* is similarly treated with advantage. When the inflammation is recent, the abdomen may be covered with an ice-bag of sufficient size. It has been shown that not only may the local symptoms of inflammation be abated in this way, but the general temperature of the body be thus reduced. It is proper, in making these cold applications, to interpose a napkin or towel between them and the skin.

Pounded ice is an excellent application to *strangulated hernia* to favor reduction, and this has often been sufficient when the taxis failed. *Hæmorrhoids* that are much swollen and painful, or that bleed, are much improved by applications of ice. *Bubo* and *swelled testicle* are greatly benefited, and the pain attendant on them relieved, by ice.

Cold to the abdomen in the form of ice or cold water, and ice-water thrown into the uterus, or ice introduced into the cavity of the womb, are measures of great utility in *uterine hæmorrhage*, whether from threatened *abortion* or *post partum*.

Hot-water injections, or the hot douche, is one of the most effective measures to be used in *chronic metritis*. A large quantity of water and frequent applications are needed to procure the best results. Not less than a quart of water as hot as can be borne, and three applications each day, are necessary. A Davidson's syringe, a vessel containing hot water, and a suitable vessel to receive the water as it flows away, are the materials needed for the vaginal douche. The first effect of this is to increase the blood-supply, but a marked degree of pallor of the mucous membrane follows, the opposite effect to that caused by cold water. When there is great relaxation of the vaginal passage and the uterus is large and spongy, the cold douche is more serviceable. Excellent results are sometimes obtained by the alternate use of the hot and cold douche. The free use of filtered rain-water has proved very efficacious in *albuminuria*, and to effect the solution of renal calculi. It must be drunk in large quantity. The good effects of Bethesda and of other weak alkaline waters must be referred to the same action; for these waters can be drunk in larger quantity without distressing the stomach, than the hard waters. They must be used freely and for many months, to accomplish curative results.

The applications of water in *surgical practice* are numerous and important. As a dressing for *wounds, contusions, and inflamed parts*, it is in universal use. The author is convinced that the cold-water treatment of wounds is often overdone, the circulation in the wounded part being too much depressed, whence repair is slow, or sloughing is induced. The hot-water dressing, or the immersion of the affected part in hot water (95° to 100° Fahr.), as proposed and practiced by Prof. F. H. Hamilton, of New York, is a method which promises most successful results:

> "The phenomena usually observed in cases of recent lacerated or incised wounds, when submerged, are a sense of comfort, yet not absolute relief from pain; on the second or third day the parts adjacent are swollen but not much reddened; the integument generally assumes a white and sodden appearance, and with only slight tenderness. On the fifth, sixth, or seventh day the swelling is greater than usually accompanies other plans of treatment, and, with the inexperienced, is likely to excite alarm; but it is found not to be attended with increased tenderness, and it pits under pressure, showing that it is a condition of œdema chiefly. At this time the granulations are generally covered with lymph, or some exudate of a whitish color, and which might easily be mistaken for a diphtheritic deposit. At the end of fourteen days or thereabouts (the period at which, in most cases, we substitute fomentation for submersion) the limb is still œdematous, the granulations are abundant, sometimes presenting a fresh red appearance, and at others covered with the white exudate."

Prof. Hamilton further remarks:

> "No treatment hitherto adopted, under our observation, has been attended with equally favorable results. Under this plan the area of acute inflammation is exceedingly limited; erysipelatous inflammation has been uniformly arrested or restrained when it has actually commenced, and it has never originated after submersion; gangrene has in no instance extended beyond the parts originally injured, and, when progressing, it has in most cases been speedily arrested (in gangrene, hot water, or water at a temperature of from 100° to 110° Fahr., is to be preferred). Septicæmia and pyæmia have not ensued in any case in which submersion has been practiced from the first day of the accident. Purulent infiltrations and consecutive abscesses have been infrequent, and always limited

to the neighborhood of the parts injured, and of small extent. Traumatic fever, usually present after grave accidents, when other plans of treatment have been pursued, as early as the third or fourth day, has seldom been present when this plan has been adopted, and in no case has the fever been intense or alarming."

For the immersion of hand, foot, arm, and leg, Hamilton has constructed bath-tubs of peculiar shape. He advises this method of treatment in contused or lacerated wounds of the extremities. Simple incised wounds and amputations are unsuited to this plan of treatment.

I subjoin the titles of some of the most recent and important contributions to our knowledge of the actions and uses of water. It is proper to add that I have also consulted the works of the followers of Priessnitz, but they are singularly deficient in accurate and scientific knowledge:

BRAND, DR. ERNST. *Die Heilung des Typhus, mit einem Anhang: Anweisung für die Krankenwärter bei Behandlung des Typhus mit Bädern*, Berlin, 1868, A. Hirschwald.

BRAUN, DR. JULIUS. *Systematisches Lehrbuch der Balneotherapie*, dritte umgearbeitete Auflage, Berlin, 1873, pp. 714.

FOX, DR. WILSON. *Observations on the Treatment of Hyperpyrexia*, London *Lancet*, vol. ii, 1871, p. 231, *et seq.*

HAMILTON, DR. FRANK H. *The Medical Record*, New York, vol. ix, May 15, 1874.

JÜRGENSEN, DR. THEODOR. *Die Körperwärme des gesunden Menschen* (*Studien*), Leipzig, 1873, p. 28, *et seq.*

LIEBERMEISTER, PROF. DR. CARL. *Beobachtungen und Versuche über die Anwendung des kalten Wassers bei fieberhaften Krankheiten*, Leipzig, 1868, pp. 480.

IBID. *Ziemssen's Cyclopædia*, American edition, vol. i, p. 206, *et seq.*

IBID. *Handbuch der Pathologie und Therapie des Fiebers*, Leipzig, 1875, p. 598, *et seq.*

VALENTINER, DR. TH. *Handbuch der allgemeinen und speciellen Balneotherapie*, George Reimer, 1873, pp. 850.

HEAT.

PHYSIOLOGICAL ACTIONS.—It is difficult to assign heat to its proper position in a systematic classification. As a stimulant to the vital processes, it pertains to the class of agents promoting constructive metamorphosis; but, in its influence on the interchanges of repair and waste, the action quickly passes into the stage of waste. As its therapeutical employment is almost entirely confined to the range of constructive metamorphosis, it seems more appropriate to embrace it in this division of the subject.

The normal heat-production of the body varies singularly little in health. Every considerable rise of temperature above, every considerable fall below, the normal of 98·5° Fahr., indicates the existence of disease. The various external causes of disturbance of the heat-producing function of the body do not, in health, affect the normal standard, because of the existence of a regulating apparatus. Every one is familiar with the fact that the human body can be exposed, without risk, to a temperature much above its own standard, provided the heat-regulating function is in a condition of healthy activity. If, however, the transmutation of heat into another mode of motion can not be effected, then the complexus of morbid actions, called fever, is at once established. Every increment of heat added to the body, unable to transmute it into another mode of motion, adds to the existing temperature.

Very important alterations take place in a body, the seat of a febrile process. Increased waste, the result of more rapid oxidation, occurs; the excretion of urea, and, according to some authorities, of carbonic acid, is increased; and those important and wide-spread lesions, entitled parenchymatous degenerations, develop in various organs of the body.

Modes of applying Heat.—1. SOLAR HEAT.—The rays of the sun may be applied directly to the whole surface, or to any part of the body. When the whole body is exposed to the rays of the summer sun, the head and face ought to be protected. The skin becomes warmer, the capillaries dilate, an erythematous blush appears, and the amount of blood in the peripheral vessels is increased above the normal. The rays of the sun in midsummer, ranging from 95° Fahr. to 125° Fahr., produce considerable burning heat, and cause a superficial inflammation of the skin, which is followed by desquamation. When the heat is less powerful, only an agreeable sensation of warmth may be experienced. Decidedly caustic effects may be produced by the concentration of the solar rays on a small spot of integument by a double-convex lens—a burning-glass, it has been called. This may be utilized as a means of counter-irritation.

Besides the heat, the solar rays contain chemical or actinic rays; and hence it is not improbable that chemical effects of a very important kind, or, it may be, catalytic effects, follow the application of the solar rays to a considerable portion of the body. Further, it can not be doubted that excitation of the cutaneous nerves by the heat and chemical rays of the sun must affect the condition of the brain and spinal cord, and, through the sympathetic system, the nutrition of the body.

2. ARTIFICIAL HEAT.—There are various modes of applying artificial heat. It may be dry or moist.

MOIST HEAT.—*The Vapor-Bath.*—It consists simply in the application of the vapor of water to the surface of the body. Sufficient attention, for the limits of this work, has been bestowed on this subject in the article on "Hydrotherapy."

DRY HEAT.—To the general surface of the body dry heat may be applied by simply raising the temperature of the air of the apartment, the body being uncovered. Local application of dry heat may be made to any part by means of woolen cloth, earthen plates, sad-irons, bags of salt, bricks, etc., heated to the proper temperature. The effects of these applications depend largely on the amount of heat contained in these objects. They produce at first the sensation of warmth, *redness of the skin, and may cause vesication, or deep-seated burning and destruction of the tissues.*

The Turkish Bath.—This differs from the Russian bath, in that it consists of dry air without the presence of the vapor of water. The human body can exist in dry air at a very high temperature, without injury, for a short period, provided it is in a state of health. The temperature of the air of the Turkish bath ranges from 95° Fahr. to 100° Fahr., but the highest point is attained at the conclusion of the process. There are usually three apartments, so that the patient passes from one grade of temperature to another, and thus avoids the unpleasant, even dangerous, effects of high heat suddenly applied. When the temperature reaches 110° Fahr., already some distress is experienced. As the heat increases, the breathing becomes short, hurried, and labored; the action of the heart is tumultuous; an unpleasant sensation of heat and irritation, with itching, is felt over the whole body; the head has a feeling of fullness, with constriction of the forehead and ringing in the ears; perspiration soon begins, and, when the temperature reaches the highest point, is very profuse.

It is obvious that a decided impression is made on the organism by a Turkish bath. The first effect of the heat is on the sensory nerves—the impression of warmth. The peripheral vessels dilate, and, of course, admit into them a larger amount of blood, with the effect to diminish the amount of blood in the internal organs. The temperature of the blood rises with the increase of heat; the action of the heart corresponds, and a state of fever would be quickly induced if the excess of heat were not at once disposed of by the perspiration, in which, according to the doctrine of the correlation of forces, it disappears as motion. The circulation being more rapid, and the peripheral vessels containing more blood, a more active metamorphosis of tissue probably takes place. Elimination is more active through the skin, but is less active through the intestinal canal and the kidneys. The acidity of the urine is increased, and the water and salts are relatively diminished. Remotely, the tension of the vascular system falls, absorption becomes more active, the muscular tonus declines, and the sensibility of the nervous system and of the special senses is lowered.

THERAPY.—Warm applications possess a high degree of utility in the various *painful and inflammatory affections of the abdominal organs.* Acute peritonitis, local or general, is probably more frequently benefited by applications of ice. As a rule, the feelings of the patient furnish the guide to the selection of the temperature. In the absence of any specific indication from the feelings of the patient, the following rule may be adhered to: If the case be one of pain without fever or inflammation, warm or hot applications; if inflammatory, cold. Those materials which retain heat and moisture longest are to be preferred; for example, the material known as spongio-piline, poultices of flaxseed-meal, flannels wrung out in hot water and covered with oiled-silk, etc. When the weight of the application is objected to, a light material, like a bag of hops dipped in hot water, may be applied. In affections of the pelvic viscera, the same modes of application can be resorted to, under the same conditions.

Heat, especially dry heat, is a very important remedy in sudden and alarming *depression of the vital powers*, with feebleness of the heart's action and coldness of the surface. Active hæmorrhage, of course, contraindicates its employment. Feeble infants, born at term or prematurely, are often saved by the application of dry heat—the highest temperature which can be borne without blistering being necessary. The *methodus medendi* is simple enough: the heating of the blood in the superficies of the body increases the movement of both heart and lungs. High heat, especially if long continued, is decidedly contraindicated in cases of fatty and fibroid degeneration of the heart, in cases of carditis, considerable obstruction of the orifices, etc.

Hot-air baths, and hot applications of any kind, may be dangerous in old subjects, and in those persons of middle age who present the evidences of degenerated vessels. Not unfrequently, attacks of *migraine*, cases of ordinary *neuralgia* of the fifth, *tic-douloureux* of mild form, etc., are relieved by hot, dry applications made over the course and peripheral distribution of the affected nerves. *Stupor and coma*, due to *uræmia*, or to *narcotic medicines*, may be relieved by dry heat applied to the neck. The alternate use of cold and heat is generally more efficient. In *neuralgia* of the larger nerves, dry heat is palliative. In irritable spine, the so-called *spinal irritation*, dry heat is an efficient remedy. In these cases solar heat is especially serviceable—the sun's rays falling on the spine, or, what is better, the rays concentrated by a burning-glass on various points on the spine.

Probably the most generally useful application of dry heat is in the treatment of *chronic rheumatism* and in *general dropsy*. In the treatment of these maladies, elimination is the object to be accomplished: in the one case, of certain excrementitious substances, notably of uric acid; and in the other, of water by the skin.

The Turkish bath has an unquestionably good effect in constitutional syphilis. Here there are two objects to be accomplished—to promote the action of the mercurial medicines and of the ptisans, and to secure elimination through the skin. In the same way the Turkish bath is highly useful in *plumbic, mercurial, and paludal cachexiæ*. Our French colleagues maintain the superior value of sulphur-vapor baths in the cachexiæ produced by the mineral poisons.

AIR.

The Atmosphere.—As a therapeutical agent, only, is air to be considered here. Nevertheless, various hygienical relations of the subject are also therapeutical, and must therefore be included.

COMPOSITION.—The atmosphere is a mechanical mixture of oxygen, nitrogen, and we should also add carbonic acid, and the vapor of water. In round numbers there are 21 parts of oxygen, 79 parts of nitrogen by volume, and ·033 per cent of carbonic acid. The essential constituents—oxygen and nitrogen—are quite uniform in proportion in all parts of the world, but the carbonic acid and vapor of water vary considerably, owing to local causes. Contrary to the generally received opinions, the quantity of carbonic acid is greater at the tops of the highest mountains than on the plains, and the oxygen less. The amount of moisture is determined chiefly by temperature, and when the air can contain no more, it is said to be *saturated.* A trace of ammonia also is present in the air, and a minute quantity of active oxygen or ozone.

When a beam of electric light is made to traverse the atmosphere, minute particles, previously invisible to the eye, and some even extra-microscopic, come into view. The lowest forms of life—microzymes, bacteria, etc.—are found in great numbers ; in cities, particles of carbon, lime, and other earthy matters, fibers of cotton and woolen cloth, leather, ordure of animals, etc. ; in the country, pollen of plants, and particles of vegetable tissues ; in hospital wards, pus-cells and other matters derived from the persons, wounds and discharges, bedding, and utensils of the sick. We owe our present knowledge of these accidental constituents of the air chiefly to the researches of Prof. Tyndall.

Various gaseous matters are also accidentally present in the air, varying in different localities in consequence of local telluric conditions, and certain trades and manufactures. As respects the first, there are carbonic acid and carbonic oxide, sulphureted and phosphureted compounds of hydrogen, marsh miasm, etc. Under the second may be included sewer-gas, gaseous emanations from decomposing animal matter, from chemical works of various kinds, etc.

PHYSIOLOGICAL EFFECTS.—1. *Pure Air.*—When air is breathed in the process of respiration, the oxygen passes into the blood, and carbonic acid, the vapor of water, a trace of ammonia, and some organic matter, pass out. The blood which leaves the lungs is changed in color, from the dark, purplish hue of venous, to the scarlet of arterial blood ; it has gained oxygen, and lost carbonic acid and water. The cause of the diffusion of gases in the lungs is chiefly the difference in tension of the gases in the blood and in the atmosphere—the tension becoming equal in the process of respiration (Hermann).

In the tissues where oxidation processes are taking place, there is, also, a respiration process going on, consisting in the formation and excretion of carbonic acid.

2. *Impure Air.*—So essential to life is the supply of oxygen to warm-blooded animals, that they can not be deprived of it, even for a

very short time, without danger to life. As pure oxygen can not be inhaled for any considerable period without injury, admixture with some "indifferent gas" becomes necessary. Thus nitrogen is utilized in the formation of atmospheric air. The other indifferent gases are hydrogen and light carbureted hydrogen, or marsh gas: when mixed with oxygen, they can be breathed with impunity; when inhaled alone, they cause dyspnœa and asphyxia.

Certain other gases are entitled "irrespirable," because, owing to the chemical actions instantaneously set up, they can not be inhaled. Some of these irrespirable gases are acid—as carbonic, muriatic, hyponitrous, sulphurous, etc.; others form acids by combination with oxygen, as nitric oxide, etc.; others are alkaline, as ammonia; others establish an ozonizing action, as chlorine, bromine, etc.

Other gases are comprehended in a group as "poisonous," of which there are three classes. The first class contains those which seize and combine with the oxygen of the blood, decomposing hæmoglobin. They are hence called "reducing gases," of which sulphureted hydrogen, phosphureted hydrogen, etc., are examples. The gases of the second class displace the oxygen and enter into combination with the hæmoglobin. Carbonic oxide and nitric oxide are examples of these displacing gases. The third class contains the gases used for the production of anæsthesia.

In the process of respiration, the air loses its oxygen, nitrogen is relatively partly increased, carbonic acid accumulates, and certain ill-defined "organic matters" appear. This vitiated air exerts a most injurious influence, and soon becomes unfit to sustain life. The amount of carbonic acid which can be breathed without injury has not been definitely ascertained, but is greater than is commonly supposed. According to Pettenkofer and Voit, 10 per 1,000 volumes produce no discomfort. When, in a crowded apartment, headache, vertigo, and feeble circulation are apparently caused by the quantity of carbonic acid present, these results are in part due to the lessened supply of oxygen, and to the action of nitrogen and organic matters.

The foul air from cesspools and sewers affects the health of man in two modes: by the direct action of the gases of decomposition, and indirectly by acting as carriers of the germs of disease. As respects the former, its injurious influence has probably been exaggerated; for the original observation of Parent-Duchatelet, that workmen engaged in cleaning the sewers of Paris suffered from no diseases due to their occupation, has been abundantly confirmed in the subsequent experience of the French officials. It is probable, also, that certain persons possess a high degree of susceptibility to the action of sewer-gas, and are affected by comparatively minute quantities. When sewer-gas is admitted to private houses, and is breathed by such susceptible persons, they decline in health, become easily fatigued, lose appetite and suffer with nausea and diarrhœa, waste, and have an earthy, sallow complexion. If the gas is more concentrated, they experience more acute symptoms, and have attacks of a choleriform character. Of course, asphyxia is produced when the gas is so concentrated as to displace oxygen entirely, as is the case sometimes in old drains and privy-vaults, the air of which, as is well known, may extinguish life speedily.

Sewer-gas, examined microscopically, is found to be loaded with minute particles, the lowest forms of life, etc., and hence it is in a high degree probable that the germs of fevers, dysentery, cholera, diphtheria, etc., may in a similar manner be conveyed by it.

Effects of Compressed Air.—Our knowledge of this subject is derived in part from observations made on workmen engaged in underground avocations requiring them to labor under greatly increased barometric pressure; in part from observations made on patients undergoing the compressed-air treatment; and in part from experimental researches on animals.

Not to enter too far into details out of place here, it suffices to state that the inhalation of compressed air lessens the respiratory movements and the number of heart-beats, and increases the arterial tension. The effect of this change in the conditions of the circulation is to diminish the amount of blood in the veins and auricles, and to increase it relatively in the ventricles (Sanderson). On ophthalmoscopic examination of the fundus oculi it has been ascertained (Von Vivenot) that the blood-vessels of the retina diminished in size with the increase in the pressure. Compressed air does not appear to influence materially the production of carbonic acid, but it does the absorption of oxygen (Von Liebig). The changes induced in the phenomena of life under high barometric pressure have been carefully studied by Paul Bert, who seems to have established that the evil effects of such pressure are largely due to the formation of bubbles of gas in the blood. He finds that nitrogen is dissolved in the blood during the time of high pressure, and returns to the gaseous state when the pressure ceases. He further ascertained that the bubbles of gas obstructed the circulation at various points, especially in the lumbar portion of the spinal cord, causing paraplegia. When the accumulation of gas was sufficient in amount, the pulmonary circulation was obstructed and the heart paralyzed by the sudden distention. MM. Blanchard et Regnard have studied the changes taking place in the spinal cord under the action of nitrogen. Numerous hæmorrhagic foci, and evidences of parenchymatous myelitis, were discovered in the entire cord. The myelitis presented the usual characteristics: hypertrophy and varicosity of the axis cylinder, and granular change at various points, but least pronounced in the lumbar portion of the cord, and most decided in the dorsal region.

AIR AS A THERAPEUTICAL AGENT.—As a general rule, the sick require more air-space than the healthy. The mere cubic dimensions are much less important than the amount of oxygen available for respiration; but as the sick are more readily affected by draughts than the healthy, it follows that the sick require more cubic space, and less frequent renewal of the air. It seems generally conceded that 2,000 cubic feet of air-space per patient is necessary in hospitals and in the sick-room to supply the needed amount of oxygen, although a less space may be better if provided with the means of frequent changes of air without sudden variations of temperature and strong currents. A large cubic space of stagnant air will be inadequate to the requirements of the sick. Even when so large an amount of air as 3,700 cubic feet per hour for each patient has been supplied to a hospital ward, the air in it has had a distinctly "stuffy" and offensive smell. Everybody is familiar with the fact that the sick and wounded do better in tents and in the open air, than in the best constructed military hospitals.

If, as has been affirmed by the highest sanitary authorities, 1,000 cubic feet of air-space is necessary to a healthy adult, it is clear that the sick require not less than we have named, 2,000; for the renewal of the air in the case of the latter must be less rapid. As the means for the renewal of the air in the sick-chamber in private houses consist of doors, windows, and fireplaces—or natural ventilation—the supply to the patient is variable. To insure the best results under these circumstances, the bed should be so placed as to be without stagnant corners and recesses, and yet not within the range of currents or draughts. When the air is still, movements may be produced by burning a lamp in the chimney. In cold weather the fire in the fireplace induces a strong upward current in the chimney, the air coming from all the crevices. It would be quite beyond the subject-matter of this treatise to consider the various mechanical contrivances which have been proposed, and are now used, to secure proper ventilation in public institutions and hospitals; but it may be useful to mention those devices by which natural ventilation in the sick-chamber may be promoted.

Where there are opposite windows, cross-draughts may be prevented by the following expedients: 1, by giving an upward slope to the window so that the current of fresh air is deflected toward the ceiling; 2, by having some of the window-panes doubled, the outer one having a space at the bottom of the pane, and the inner one at the top; 3, by fastening a block to the upper sash which prevents closing. If there are windows at one side only, the room may be efficiently ventilated by vertical tubes carried up the walls from some distance (a few feet) and communicating with the external air.

In the *fevers*, *exanthemata*, *diphtheria*, *dysentery*, etc., an abundant supply of air is a measure of the highest utility. The result in a doubtful case may be determined by the amount of oxygen received by the patient. Furthermore, free admission and exit of air is the most efficient means of destroying disease-germs, and their retention in a stagnant atmosphere intensifies their virulence. In febrile affections, the apprehension of "taking cold" may be allayed by the assurance that the condition of fever is preventive. Draughts, however, should be avoided in measles and in all affections of the breathing organs.

There are two conditions in *diseases of the respiratory organs*, in which an abundant supply of air is essential: *inflammatory affections* in which the breathing space is encroached upon so that the oxygenation of the blood is hindered; and chronic maladies, as *emphysema*, *asthma*, etc., in which labored breathing is a consequence in part of mechanical defects. Considerable diminution in the supply of air has a powerful influence in the production of *consumption*. The statistics on this point collected by the English Sanitary Commission seem conclusive, and, since their recommendation of increased cubic air-space in the barracks, the number of cases of phthisis has materially diminished. In the treatment of this disease, a suitable supply of air becomes even more imperative. The subjects of this disease should occupy apartments, whenever practicable, provided with ample windows and fireplace, and frequent renewal of the air day and night should be secured by some of the contrivances now used for this purpose and already referred to. Whenever, by reason of fever or debility, exercise in the open air can not be taken, the patient, suitably clad and protected in severe weather, may sit in an apartment with all the windows and doors open, a part of each day.

Maladies characterized by a deficiency in the oxidation processes throughout the body require increased supply of air under all the circumstances of life. The most important of these are *diabetes*, *gout*, *rheumatism*, *obesity*, *excess in the production of lithates*, etc. The good effects of open-air exercise in these disorders result chiefly from the increased consumption of oxygen. *Anæmia*, *chlorosis*, *convalescence* from acute diseases, and *chronic wasting maladies*, also require increased consumption of air: the oxygen is even more important than the iron which is given so profusely in these cases; indeed, without additional oxygen, the assimilation of the iron can hardly be accomplished.

THERAPEUTICAL APPLICATIONS OF COMPRESSED AIR are effected by two modes: by placing the patient in a chamber in which the air has been condensed by an air-pumping engine; and by having the patient breathe, through a mask closely fitting the mouth and nose, air compressed in a portable reservoir. The latter method only is ordinarily available. Without entering into minute details, it will suffice to say that the former method consists of an air-tight chamber eight feet high and seven feet wide, in which three patients can sit comfortably. The air is compressed gradually to one and a half atmospheres —a pressure of twenty-two pounds to the square inch—and the patient remains in the chamber about an hour and a half. One of the first and most complete arrangements of this kind was erected under the supervision of Dr. Liebig (not the chemist) at Reichenhall, Bavaria ; and he has since communicated the results of his large experience to the *Aerztliches Intelligenz-Blatt* of Munich. The portable apparatus now most used is that of Waldenburg (*der transportable pneumatische Apparat*). This consists of an outer cylinder containing some water, and an inverted inner cylinder containing air, which fits into the outer one. Obviously the air within may be condensed or rarefied by lowering or raising the inner cylinder, which is easily effected by applying weights. A mercurial manometer indicates the degree of condensation, and a water-gauge the height of the water. With the air-chamber a flexible tube, having an oro-nasal mask attached, communicates. With this apparatus the patient breathes either condensed or rarefied air at the will of the operator. The author has had arranged for his own use a pneumatic apparatus which can be employed for inhalation of compressed or rarefied air, and for the atomization of liquids. It is only available in cities where a sufficient water-pressure can be obtained. It consists of a brass cylinder strongly made, and containing at the top a stop-cock and pipe for the admission of water, and at the bottom a stop-cock for drawing off the water. At the top, also, there is a stop-cock and pipe for the attachment of the flexible tube and oro-nasal mask, and a gauge for registering the pressure. The admission of water effects the compression of the air ; its removal—all the stop-cocks being closed—effects the rarefaction. Precisely the same results can be attained as in the more complicated arrangement of Waldenburg. Furthermore the author's apparatus can be employed as an atomizer, using compressed air or steam.

The applications of compressed air are numerous and important. The results are chemical and mechanical. The chemical effects are due to the increased supply of oxygen ; the mechanical, to the distribution of the blood-pressure. In *anæmia*, *chlorosis*, *amenorrhœa*, in the *neuralgiæ*, especially of the fifth nerve, *headache*, *epistaxis*, in *gout*, *diabetes*, *obesity*, etc., very excellent results are obtained by the use of compressed air—which means the increased consumption of oxygen. To achieve all that is possible to effect in these cases, the treatment must be continued for a considerable time.

It is, however, in certain cardiac and pulmonary affections that the pneumatic treatment is especially commended. *Acute catarrh*, nasal, faucial, bronchial, if early applied ; *chronic bronchitis*, with or without *emphysema*, *capillary bronchitis*, *atelectasis*, *asthma*, *dilatation of* *the right cavities*, and fullness of the venous with ischæmia of the arterial system, are conditions in which the compressed air is signally beneficial. Probably in emphysema, more than in any other malady, has the relief afforded by this treatment been most conspicuous; for this is a disease which has hitherto offered few results to therapeutical skill. "Die Exspiration in verdünnter Luft ist das specifische mechanische Antidot des Emphysems," is the dogmatic statement of Waldenburg—"Expiration into rarefied air is the specific mechanical antidote to the emphysematous affections."

The rules for the inspiration and expiration of rarefied and condensed air respectively may be formulated as follows:

As inspiration of condensed air increases the intra-thoracic air-pressure, it impedes the flow of blood to the right auricle, and lessens somewhat the pulse-rate, and is accordingly indicated in cases of dyspnœa having a mechanical origin, in incipient phthisis, in asthma, bronchitis, and in insufficiency of the mitral.

As inspiration of rarefied air has the opposite effects to those of condensed air, its use is indicated in the few cases in which increased inspiratory power is desirable, as in contracted thorax, the result of effusion.

Expiration into condensed air increases the expiratory power when deficient, and expiration into rarefied air is indicated in emphysema and chronic bronchitis.

Hot Air.—Since it has been shown by Pasteur that the vinous fermentation is arrested by raising to the temperature of 160° Fahr. the bottles containing new wine, this fact has been extensively applied, and is called Pasteurism. Recently the breathing of hot air has been brought forward as a remedy for phthisis, and the results of the practice have been good. The air, *washed*, is heated by a Bunsen's burner, and then breathed by the patient for a time which is determined by the condition. A heat of 200° Fahr. is the initial temperature, and this is raised up to 300°, even 400°, and the time occupied from a half to two hours, several times each day.

MASSAGE.

Definition. — The term *massage* is probably derived from the Arab word *mass*, which signifies "to knead." The French word *massage* is equivalent to the term shampooing, and is applied to a process of rubbing, friction, and percussion of the body. *Masseur* is a male rubber, and *masseuse* a female rubber—that is, persons who make a business of massage.

Method.—Massage by friction consists in rubbing, rolling under the fingers, and gently pinching the skin, and rubbing, tapping, kneading, and exercising the muscles and joints. Beginning at an extremity, the foot for example, the skin is taken up between the thumb and fingers and rolled and pressed; then the muscular masses are well grasped, rolled and pressed and kneaded, and rapidly tapped a quick succession of light blows; and then each articulation is in turn put through all of its motions. Even the muscles of the neck and the interossei may be subjected to the same treatment, with a little address and painstaking. In fact, no part of the body should be omitted except the face.

Massage by percussion alone consists in applying to various parts of the body a very rapid succession of short blows, not forcible enough to cause pain. The blows or taps may be made with a wooden spatula, with the fingers as arranged for percussion, or with the lateral margin of the hand fully extended.

Dr. Mortimer Granville has accomplished notable results in the treatment of neuralgia by rapid percussion over the trajectory of the nerves affected. He has devised a small instrument for this purpose, called *percuteur*. The curative results of this delicate percussion are attributed by Granville to a modification in the nerve-molecules.

PHYSIOLOGICAL EFFECTS.—The good effects of massage are popularly ascribed to electrical or supernatural agency. That electrical currents are induced by massage is true, but the curative effects are attributable to other agencies.

The effects of massage are: 1, local; 2, systemic.

1. The masseur or rubber puts forth more or less muscular power, which at the points of contact or friction develops or is transformed into another mode of motion—heat. The action thus induced in the constituent tissues of the parts operated on, also serves to elevate the temperature. The vessels dilate and an increased quantity of blood enters them, and the motion of the blood-current is accelerated. The immediate effect of these changes is to promote the nutritive energy of the tissues subjected to friction. This result is seen in the improved color, warmth, and volume of the parts.

2. A general rise of temperature, equal in most instances to one degree, has been observed to take place quite uniformly (Mitchell). The body increases in weight; all the organic functions are performed with more energy, and power is gained in every way. Massage in its several forms exercises peculiar effects on the nervous system, which should not be overlooked. When an inflamed part which can be manipulated, a joint for example, is rubbed with excessive gentleness, the sensibility, which was at first so acute that every touch gave pain, rapidly subsides, until, after an hour of friction, it may be handled with some roughness, without evoking painful sensations. When the local condition is that of pain merely, it is remarkable how the acutest suffering is alleviated by persistent friction of a gentle kind. Again, the state of spasm of a muscle is relieved and relaxation induced by persevering rubbing of the affected muscle. Results such as these are

explicable only on the theory that the gentle titillation of the cutaneous branches of the nerves (end-organs) has so far lowered their irritability that they cease to receive and transmit painful impressions. The rapid and long-continued transference to the centers of conscious impressions of the gentle titillation of the end-organs allays the irritability of the center, so that, if pain be transmitted, it excites no reaction, and therefore is not realized.

Therapy.—Obstinate *wakefulness and nocturnal restlessness* may often be relieved by massage of pressure or percussion. Very gentle and long-continued friction of the extremities, especially of the lower extremities, is necessary, or corresponding tapping. Simple *headache*, even severe paroxysms of *neuralgia*, and the spasms of *tic douloureux*, are often most surprisingly relieved by, at first, exceedingly delicate frictions of the end-organs of the fifth—the skin of the face, forehead, neck, and the scalp—and subsequently stronger rubbing of the same parts. The same method has been effective in *hemicrania*, *migraine*, and *spinal pain* (Westerlund, Graham, Putnam, and others). Next to electricity, massage is the most useful remedy we possess in the treatment of *infantile paralysis* and other wasting palsies, after the acute symptoms have subsided. In *hemiplegia* and other forms of paralysis due to intra-cranial lesions, the indications for the treatment by massage are a lowered state of the nutrition of the paralyzed parts, coldness and blueness of the skin, wasting and contracted muscles, ulcerations, etc. In *progressive muscular atrophy*, much more may be accomplished by persistent frictions and kneadings of the wasting muscles. The treatment should be begun early, and the first indications—pain, fibrillary trembling, weakness, etc.—require the massage, without waiting for obvious wasting. Of course, any treatment is useless when the wasting has proceeded so far that no muscular elements remain.

Probably massage has accomplished more conspicuously good results in *chronic joint affections*, *synovitis*, *contractions and deformities*, and *thickening from inflammatory deposits* (Berghmann and Helleday, Billroth, Mosengeil, and others). It is in this class of cases that healers, natural bone-setters, and other empirics sometimes achieve surprising success in the face of failures by regular surgeons. The author therefore especially urges on young surgeons and physicians the extraordinary utility of massage in this group of cases, and the great results which can be achieved by it, when sections of muscles, tendons, and cicatrices may appear to be imperatively demanded. In many cases patient and long-continued use of the method may be required.

In the hands of Weir Mitchell, massage has proved of surprising benefit in cases of the so-called *spinal irritation*, with its protean manifestations in the nervous, muscular, digestive, and sexual systems.

He uses it as a means of promoting the nutrition of the body generally, and of the muscular system particularly, while he maintains the body in a condition of nearly absolute rest.

As the results obtained have been surprisingly great, it were better to indicate with some particularity the kind of cases to which massage seems best adapted, and we can do no better than employ the graphic language of Mitchell: "It includes that large group of women, especially, said to have nervous exhaustion, or who are described as having spinal irritation, if that be the prominent symptom. To it I must add cases in which, besides wasting and anæmia, emotional manifestations predominate, and which are then called hysterical, whether or not they exhibit ovarian or uterine disorders. Nothing is more common in practice than to see a young woman who falls below the health-standard, loses color and plumpness, is tired all the time, by-and-by has a tender spine, and soon or late enacts the whole varied drama of hysteria. . . . But no matter how it comes about, the woman grows pale and thin, eats little, or, if she eats, does not profit by it. Everything wearies her—to sew, to write, to read, to walk—and by-and-by the sofa or the bed is her only comfort."

"In the treatment of these, massage plays an important part. Rest, electrical excitation and exercise of the muscular system, systematic feeding, are employed in conjunction with massage."

How far the results in the treatment by massage are affected by psychical impression has not been ascertained. The separation of these patients from home influences and associations, the confinement to bed, and the novel treatment, combine to affect the imagination profoundly, and to arouse hope and expectation to the highest point. In the class of cases described by Mitchell, these mental influences are powerful factors both in causing and curing morbid mental states. In illustration may be quoted Davy's celebrated case of paralysis cured by the mere application of the thermometer, and the remarkable recoveries which occurred under the religious ministrations and prayers of Prince Hohenlohe.

The extraordinary effects produced by the application of certain metals in hysterical subjects (Burq's Metallotherapy) may also be quoted in illustration. The results obtained by Charcot from metallotherapy have been even more remarkable than the cures effected by Mitchell with massage.

THE MUSCLE-BEATER.—Massage has its ill effects, and is now, like the "rest-cure," much overdone. Besides the expense and inconveniences of the treatment, it is used injudiciously in cases of debility, and in convalescence, when the material produced is not in excess of the needs.

The muscle-beater may well be substituted for massage in many cases. It is composed of a wooden handle of size convenient to be grasped, sixteen to eighteen inches in length, and at the end are placed two elastic balls of vulcanized caoutchouc, having a diameter of two and a half to three inches. Each ball has a small hole in it to permit the entrance and exit of air. With this instrument blows of varying force and frequency can be made over the body as a whole, or to any part.

DIGESTION-FERMENTS.

Pepsin.—*Pepsina vel pepsinum ; pepsina porci ; pepsine*, Fr. ; *Verdauungsstoff*, Ger.

DEFINITION.—A proteolytic ferment or enzyme obtained from the glandular layer of the fresh stomach of the pig. There are two processes worthy of mention for obtaining the ferment : Scheffer's, and Prof. Lionel S. Beale's. By Scheffer's process the mucous membrane is digested in a solution of muriatic acid, and the pepsin precipitated with chloride of sodium. Beale directs that the mucous membrane be first cleansed and then scraped strongly with an ivory knife, so as to remove the contents of the gastric glands. The pepsin is contained in the very viscid mucous which is thus removed. When spread on clean glass in a very thin layer, it is dried at a temperature not to exceed 100° Fahr., and in the vapor of hot water or over sulphuric acid.

PREPARATIONS.—*Pepsinum Saccharatum.*—Pepsin, 10 grm., and sugar of milk, 90 grm. "One part of saccharated pepsin dissolved in 500 parts of water acidulated with 7·5 parts of hydrochloric acid should digest at least 50 parts of hard-boiled egg-albumen in five or six hours, at a temperature of 100° to 104° Fahr." Dose, ℈j—ʒij.

Liquor Pepsini.—Solution of pepsin is composed of saccharated pepsin in solution in water and glycerin, and acidulated with hydrochloric acid. Dose : a teaspoonful *ter in die*, usually after meals. The wine of pepsin is an unscientific preparation, and should not be prescribed. Boudault's (really Corvisart's) compound nutritive powder, consisting of pepsin, starch, and lactic acid, is an exceedingly uncertain preparation, and is often totally inert. Only those preparations of pepsin should be used, made by the processes above described, especially those of E. Scheffer, of Louisville, Ky. The saccharated pepsin and the glycerole are practically unchangeable.

INGLUVIN is a proprietary preparation, said to be made of the gizzard of the domestic chicken by drying and pulverization. Dose, gr. v—℈j. Ingluvin has the remarkable property of arresting certain kinds of vomiting—notably the *vomiting of pregnancy*. It is a stomachic tonic, and relieves *indigestion*, *flatulence*, and *dyspepsia*.

Recent investigations have shown that ingluvin owes its curative effects, not to any ferment corresponding to pepsin, but to *a peculiar bitter principle*. This result is the more satisfactory, since such an organ as the gizzard could hardly furnish the necessary quantity of a digestive ferment to effect the results now known to be produced by ingluvin.

Under ordinary circumstances, and when the object of its administration is to promote the digestive function, it should be taken after meals. When the object is to arrest the vomiting of pregnancy, it should be given before meals.

But only the successful use of this agent and the apparent sincerity of the composition as given to the public would seem to justify its mention here; but no doubt need be felt as to the propriety of using a patented preparation if there is no substitute of equal value.

Pancreatin. Pancreatic Emulsion. Liquor Pancreaticus.—Pancreatin is a mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog (*Sus scrofa*, Linné. Class, *Mammalia ;* order, *Pachydermata*).

Pancreatin occurs in transparent, brittle, yellowish scales, or a yellowish or yellowish-white or grayish powder, odorless, or having a faint, peculiar, not unpleasant odor, and a somewhat meat-like taste. It is slowly and almost completely insoluble in water, insoluble in alcohol. It digests albuminoids, converts starch into sugar in presence of alkalies; prolonged contact with acids renders it inert. In the presence of an alkali it has the power to convert proteids into peptones, to emulsionize fats, etc. As acids destroy pancreatin, it follows that the liquor pancreaticus should not be given while stomach digestion is going on, but when the chyme has entered the intestine, in about three hours after the taking of food (Roberts).

In cases of very weak digestion, Roberts suggests the employment of "peptonized" foods—i. e., foods that have been acted on by pancreatin and the proteids converted into peptones. The following formulæ proposed by Roberts will be found useful in some conditions of disease:

"*Peptonized Milk.*—A pint of milk is diluted with one fourth water, and heated to 140° Fahr. Two or three teaspoonfuls of liquor pancreaticus, and ten to twenty grains of bicarbonate of soda, are then mixed therewith. The mixture is then poured into a covered jug, and the jug is placed in a warm situation under a 'cozy' in order to keep up the heat. At the end of an hour or hour and a half, the product is boiled for two or three minutes. It can then be used like ordinary milk."

"*Peptonized Gruel.*—Gruel may be prepared from any of the numerous farinaceous articles which are in common use—wheaten flour, corn-meal, oatmeal, arrow-root, sago, pearl-barley, pea-flour. The gruel should be very well boiled, and made thick and strong. It is then poured into a covered jug and allowed to cool to a temperature of about 140° Fahr. Liquor pancreaticus is then added in the proportion of a tablespoonful to the pint of gruel, and the jug be kept warm under a 'cozy' as before. At the end of a couple of hours the product is boiled and finally strained." In this process the starch is converted into sugar, and the albuminoid matters are peptonized, whence the gruel assumes a thin, watery consistence. Peptonized gruel is administered with peptonized milk.

"*Peptonized milk-gruel* is prepared as follows: Gruel is made in the usual way, thick and strong; to this while boiling is added an equal measure of milk. To each pint of the mixture add two or three teaspoonfuls of liquor pancreaticus and twenty grains of bicarbonate of sodium. It is kept warm for a couple of hours, then boiled for a few minutes and strained."

SYNERGISTS.—Lactic and chlorhydric (muriatic), acetic, citric, and malic acids, promote the digestive activity of pepsin.

PHYSIOLOGICAL EFFECTS.—Ten grains of the saccharated pepsin, prepared by the process of Scheffer, will dissolve 120 grains of coagulated albumen in four to six hours, at a temperature of 100° Fahr. Pepsin is an essential constituent of the gastric juice, and possesses the property, especially in the presence of lactic and chlorhydric acids, of digesting the nitrogenous constituents of the food (casein, albumen, fibrin, etc.), and converting them into *peptones*.

THERAPY.—Pepsin is, of course, indicated in *stomach-disorders* characterized by a deficiency of this essential principle. As Fenwick has shown, the amount of pepsin secreted by the gastric glands undergoes great diminution in various morbid states, as in cancer, diabetes, typhoid fever, and heart-disease. In convalescence from *fever*, therefore, pepsin is indicated, and in the incurable morbid states, mentioned above, it serves a useful purpose in maintaining the function of digestion. Fox "bears strong testimony in favor of pepsin" (p. 74) in cases of *atonic dyspepsia* and "irritative states of the mucous membrane." He prefers to administer it with chlorhydric acid. In the atonic *dyspepsia of phthisis* pepsin is highly beneficial, especially when given in connection with pancreatic emulsion. In other forms of dyspepsia, accompanied by imperfect solution of the fats and the formation of fat-acids, the addition of pancreatic solution greatly increases the activity of pepsin (Long).

In the *apepsia* of infants (Barthez), especially occurring in those artificially fed, great benefit is derived from the use of pepsin. Dr. Cummins has seen many apparently hopeless cases recover under its use, and he regards it as so valuable that he never recommends a wet-nurse, but relies on artificial food, the digestion of which is aided by the administration of pepsin. Corvisart used his nutritive powder (the so-called Boudault's pepsin) with happy effects in the same cases; and Barthez, who applied the term apepsia to this inability of infants to digest their proper aliment, has been equally successful in the same mode of treatment. The saccharated pepsin should be administered in these cases in doses of ten to thirty grains immediately after the child has taken its milk or other food, or thirty minims of the glycerole of pepsin at the same time. It is better, according to M. Barthez, to give pepsin without acid to infants (Trousseau et Pidoux).

Pepsin is one of the remedies which has been used with success in the *vomiting of pregnancy*. The heaviness and torpor which are felt during the progress of digestion in some subjects, and also the *gastralgia* which is produced in this way, may be relieved by its timely administration.

According to Hollman, the use of pepsin is attended with beneficial results in *anæmia*, *chlorosis*, *atrophy*, and allied states, due, no doubt, to the better preparation of the peptones for absorption into the blood.

In *chronic ulcer* of the stomach and in *cancer* of this organ, pepsin, by facilitating digestion, will diminish the distress of the patient, and will contribute to the cure of ulcer and prolong life in cases of cancer.

Very great success has been attained in the treatment of *diarrhœa in infants* by pepsin. The form of diarrhœa amenable to this remedy is due really to an atonic state of the intestinal mucous membrane. Every motion contains half-digested food. Soon after taking milk or other food, the child becomes uneasy and a discharge takes place. Frequently undigested food is vomited as well. If this condition of things continues for any considerable time, the child emaciates, and the skin wrinkles and becomes dry and harsh. The motions will be quickly changed in character, and the nutrition of the child improved, by giving pepsin immediately after each supply of food. Facts in illustration of this statement have been published by Corvisart, Barthez, Rilliet, Trousseau et Pidoux, Ellis, of Dublin, Davidson, of Liverpool, Hawley, of Brooklyn, and others.

In cases of entire inability of the stomach to digest food, or when surgical operations or accidental injuries prevent the introduction of aliments into this viscus, *pepsin is added to the nutritive enemata* in order to insure the preparation of peptones for absorption. Mr. Malcolm Morris reports the cure of an obstinate case of *eczema* by the administration of papäin. It was due to indigestion, it is probable.

Carica Papaya.—A member of the *Passaflorineæ*. It resembles the *Cucurbitaceæ* in the form of its fruit, and by some authorities it is placed in a separate class—the *Papayaceæ*.

Composition.—The young fruit when incised furnishes an abundance of milky fluid, which is slightly bitter to the taste, and it coagulates on exposure to the air, separating into an albuminous clot and a transparent liquid resembling in this process the coagulation of blood.

The juice contains a digestive ferment which is called *papäin*, sometimes *papayotin*. It is an albuminous substance, white, amorphous, soluble in water, but insoluble in alcohol and ether. The dose of papäin ranges from 5 to 30 grains.

From the leaves of the plant an alkaloid has been obtained, called by its discoverer, Von Greshoff, *carpaine.* This substance has the usual properties of an alkaloid—combines with acids to form salts, and produces distinct physiological reactions. The dose of carpaine by hypodermatic injection is $\frac{1}{6}$ to $\frac{1}{12}$ of a grain, and by the stomach twice these quantities.

Thus far carpaine has been merely the subject of experimental investigation, and we need occupy but little space with an account of its physiological properties, the knowledge of which we owe to Van Ryn and C. L. Rümke. According to these investigators, who agree for the most part in their conclusions, carpaine is a cardiac remedy. It lowers the blood pressure, but increases the pulse rate but slightly. When the action of the heart is arrested by muscarin, it does not, like atropine, cause it to resume its movement when applied directly. It ultimately paralyzes respiration and circulation, but not by an impression made on the vagus. Its effects are really expended on the centers of respiration and circulation. It does not act on the peripheral nerves or on the muscles; it does not cause fibrillary trembling or tetanus.

Further investigations and clinical observations are necessary to determine the real place of carpaine as a remedy.

THE ACTIONS AND USES OF PAPÄIN.—It is as a solvent of albuminous substances, as a digestive, that papäin comes into consideration. As compared with pepsin its range is far wider. While pepsin is active only in acid solutions, papäin is active in neutral or alkaline, and in slightly acid solutions (Finkler, Hirsch, Sittmann, and others). Papäin is also more effective and lasting as a solvent of albuminous matters than pepsin. Strongly acid and strongly alkaline solutions are rather inimical to the digestive function of papäin, although it still preserves some degree of activity under these conditions; but in neutral and feebly alkaline solutions it is at its best working power. Too great extent of dilution impairs its effect; on the other hand, a certain degree of concentration favors its action. From these data it is obvious that papäin is more useful as a digestive ferment for all the conditions present than is pepsin, although the latter has greater energy in the presence of dilute or strongly acid solutions.

For promoting stomach digestion, in the state of *apepsia*, papäin may be utilized in place of pepsin. Sittmann finds papäin to have remarkable power to dissolve albumin, $\frac{2}{3}$ of a grain of this substance bringing about the solution of 150 grains of albumin in the course of two hours. In *acute gastritis*, he found 8 grains, taken after meals, relieve the pain and in a few days effect a cure. It has proved equally beneficial in gastric ulcer and chronic gastric catarrh by the same authority. The author has found it useful in that troublesome disorder, *membranous enteritis.* In the treatment of this disease, doses of 10 to 20 grains given after meals, at a time when stomach digestion is ended, are highly effective. For lumbricoid worms it has proved active in securing their expulsion. Cases of *tænia* have been reported cured, and the author has met with one in which daily exhibitions of papäin after meals seemed to be the effective agent in securing its discharge.

In *intestinal indigestion* due to insufficient production of pancreatic juice and consequent imperfect digestion of fats and formation of peptones, papäin is useful in a high degree. When catarrhal jaundice succeeds to duodenitis, it is one of the best remedies to bring about a return to the normal state. In all cases of intestinal disorder, and when coincident affections of the pancreas occur, papäin should be given in full doses, an hour or two after meals, and with a moderate quantity of sodium bicarbonate to neutralize any acid present.

One of the most important applications of papäin is in the treatment of false membrane, chiefly the false membrane of *diphtheria.* Bouchut was the first to conceive the idea that papäin, having an extraordinary digestive power of albumin and fibrin, must act as a solvent of a croupous exudation, and he found it true on actual trial. Jacobi, of New York, has been one of the most conspicuous advocates of this practice. He reports several cases in which the solvent action of papäin was pronounced. The solution employed by him had the strength of 1 to 8, or 1 part of papayotin to 4 each of water and glycerin, applied freely by a mop or in spray. Probably a much stronger solution would be more effective. Papäin has also been used successfully as a *vermifuge*—against the round worm and tænia. It has been supposed to act as a digestive, attacking the soft albuminous material of which these parasites are composed; but, in the case of the tape worm, certainly the action seems to be stupefying, the worm being expelled in its entirety. Considerable doses must be given night and morning until the expulsion of the worm takes place. The author found this method successful, aided by a brisk cathartic, when the passage of numerous segments indicated an uneasy state of the parasite. The dose ranges from 10 to 30 grains for this purpose. There is reason to believe that much of the papäin of commerce is not genuine, or, if genuine, much diluted. Care should be exercised to procure only genuine material in prescribing.

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ACIDS.

Acidum Lacticum.—*Lactic acid; acide lactique*, Fr.; *Milchsäure*, Ger.

Properties.—It is an acid, sirupy liquid, which contains 75 per cent of absolute lactic acid, and has a pale wine-color. Specific gravity, 1·212. It mixes in all proportions with water, alcohol, and ether.

Incompatibles and Antagonists.—Alkalies and the mineral salts.

Synergists.—Pepsin, sodium chloride, vegetable acids, chlorhydric acid, etc.

Dose.—Fifteen minims to ʒ ss in water before or after meals, according to the conditions present.

Physiological Action.—As lactic acid is a frequent constituent of the gastric juice, it has undoubtedly an important function in connection with digestion. Used medicinally, it promotes the appetite and facilitates digestion. In large doses (ʒ j) it gives rise to epigastric pain, flatulence, and loss of appetite. As lactic acid is one of a series of homologous acids, containing butylactic, valerolactic, and leucic acids, it is not improbable that some of these may result from its oxidation when administered in excess. It probably combines with bases and forms lactates, for it displaces not only the volatile but some of the mineral acids from their combinations. Chemical investigations have indeed confirmed this, for, besides free lactic acid, lactates have been found in the gastric juice. It is not known definitely whether free lactic acid occurs in the blood in the healthy state, but it certainly does in some morbid conditions. According to Lehmann, lactates are rapidly converted into carbonates in the blood. Free lactic acid, as was long ago shown by Berzelius, is found in muscular fluid, and has also been detected in the spleen by Scherer. Although it is not always a constituent of normal urine, yet, when the supply of lactates to the blood is considerably beyond the oxidizing power of the blood, it has been found (Lehmann). Scherer has shown also that lactic acid is present in the exudates of puerperal fever.

Lactic acid has the power to dissolve a considerable quantity of freshly-precipitated phosphate of lime.

The suggestion made by Prout, of a relation between an excess of lactic acid in the blood and rheumatic inflammation, received a remarkable confirmation in the experiments of Richardson, who produced endocardial inflammation by injecting lactic acid into the peritoneal cavity of dogs. Further confirmation of this connection has been afforded in the attacks of acute rheumatism which have occurred in subjects of diabetes treated by lactic acid.

Therapy.—Solutions of lactic acid are of great utility as *solvents of false membrane*. Since the comparative demonstration of solvents made by Bricheteau and Adrian, it has been employed successfully by Dr. Weber, of Darmstadt, and Dr. Dureau, in *croup*, applied by means of a *pulverisateur* in the strength of thirty to forty drops to the ounce (Waldenburg), and is also advocated by Morell Mackenzie and Lennox Browne. The following is the formula used by Mackenzie at the London Throat Hospital: ℞ Acidi lactici, ʒ iijss; aquæ destil., ℥ x. M. This may be used in a spray-producer, or be applied on a mop to the affected part. It is unquestionably an excellent solvent of the exudation of *diphtheria*, as the author has frequently observed. It may be used also as a gargle when the exudation does not extend beyond the tonsils and the pillars of the fauces. For this purpose sufficient acid may be added to water to give a distinctly sour taste. As the application is free from danger, it may be used as often as every half-hour. When used in the form of spray, care must be had to prevent the acid hurting the eyes.

Chiefly in *atonic dyspepsia* is lactic acid employed. In this condition it is, so to speak, a physiological remedy, being a constituent of the gastric juice; therefore it is supplied artificially, because the stomach is unequal to the task of producing it. Generally, it is advisable to combine pepsin with it thus: ℞ Liq. pepsinæ, ʒ xij; acidi lactici, ʒ iv. M. A teaspoonful three times a day after meals is a proper dose for an adult. In the *apepsia* of infants, characterized by the presence of undigested aliment in the discharges, this combination is an excellent remedy. If a marked degree of acidity exists, the acid should be omitted, or given before the milk, when it may prevent the excessive production of acid. In *irritative dyspepsia*, when the pain and suffering are due to slow and imperfect digestion, lactic acid will often give great relief, either alone or combined with pepsin. Cases of *acidity* and *heartburn* are often quickly relieved by lactic acid given *before meals*. When the presence of an excess of the *phosphates*, *uric acid*, and *the urates*, and of *oxalate of lime*, in the urine, is due to imperfect digestion and faulty assimilation, as is frequently the case, lactic acid is serviceable. Dr. Deecke advocates the use of lactic acid in *chronic cystitis*, as a means of arresting the ammoniacal decomposition of the urine, a condition in which he holds it to be very effective.

Lactic acid has been used with varying success in the treatment of *diabetes*. The object to be gained is the prevention of sugar formation from the starchy and other elements of the food. Dr. Foster reports some cases apparently decidedly benefited, and Dr. Ogle gives an account of two cases in which no good results were attained. Cases have been lately reported in which the patients were improved by the use of lactic acid, but, on the whole, the utility of this agent in diabetes must be held to be as yet *sub judice*, besides the danger of setting up an endocarditis, or other changes in the intima of the vessels, that might be even more serious than the malady for which prescribed.

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Mineral Acids. — *Acidum Sulphuricum.* — Sulphuric acid. "A liquid composed of not less than 92·5 per cent of absolute sulphuric acid. A colorless, oily liquid, inodorous, and having strong acid and corrosive qualities. The specific gravity of sulphuric acid should be not less than 1·835. It is miscible in all proportions with water and alcohol, with the evolution of heat."

The official preparations into which sulphuric acid enters are acidum sulphuricum aromaticum and acidum sulphuricum dilutum.

Acidum Sulphuricum Dilutum.—Diluted sulphuric acid. "Sulphuric acid, 100 grm.; distilled water, 825 grm. This contains 10 per cent of the official sulphuric acid, and has the specific gravity of 1·070 nearly." Dose, ♏ v—♏ xxx, and should be well diluted with water when administered.

Acidum Sulphuricum Aromaticum.—Aromatic sulphuric acid, or elixir of vitriol. "Sulphuric acid, 100 c. c.; tincture of ginger, 50 c. c.; oil of cinnamon, 1 c. c.; and sufficient alcohol to make 1,000 c. c. The specific gravity should be 0·955. Dose, ♏v— ʒ j, well diluted with water.

Acidum Hydrochloricum.—Hydrochloric acid, muriatic acid. "A liquid composed of 31·9 per cent of absolute hydrochloric acid and 68·1 per cent of water. It should have a specific gravity of 1·163. It is a fuming, colorless liquid, of a pungent, suffocating odor, and an intensely acid taste and reaction." The official preparations into which hydrochloric acid enters are acidum hydrochloricum dilutum, acidum nitrohydrochloricum, and acidum nitrohydrochloricum dilutum.

Acidum Hydrochloricum Dilutum.—Diluted hydrochloric acid. "Hydrochloric acid, 100 grm.; distilled water, 219 grm. This mixture contains 10 per cent of absolute hydrochloric acid, and has a specific gravity of 1·050.

Acidum Nitricum.—Nitric acid. "A colorless, fuming, very caustic and corrosive liquid, of a peculiar, somewhat suffocating odor, and a strongly acid reaction. Specific gravity, 1·414. It is composed of 68 per cent by weight of absolute nitric acid, and 32 per cent of water.

Acidum Nitricum Dilutum.—Diluted nitric acid. Nitric acid, 100 grm.; distilled water, 580 grm. Dose, ♏ ij—♏ x, in sufficient water.

Acidum Nitrohydrochloricum. — Nitrohydrochloric acid, also known as *aqua regia.* Nitric acid, 180 c. c.; hydrochloric acid, 820 c. c. Dose, ♏ ij—♏ x, well diluted.

Acidum Nitrohydrochloricum Dilutum. — Diluted nitrohydrochloric acid. Nitric acid, 40 c. c.; hydrochloric acid, 180 c. c.; distilled water, 780 c. c. A colorless, faintly yellow liquid, odorless, or having a faint odor of chlorine, and a very acid taste and reaction. Dose, ♏ v—♏ xx, in sufficient water.

Acidum Phosphoricum.—Phosphoric acid. A liquid composed of not less than 85 per cent of absolute orthophosphoric acid, and not more than 15 per cent of water. Specific gravity, 1·710. Dose, ♏ j—♏ x, well diluted.

Acidum Phosphoricum Dilutum.—Phosphoric acid, 100 grm.; distilled water, 750 grm. Dose, ♏ v—♏ xx, in sufficient water.

Acidum Hypophosphorosum Dilutum.—Diluted hypophosphorous acid. Consists of 10 per cent by weight of absolute hypophosphorous acid and 90 per cent of water.

Antagonists and Incompatibles. — Alkalies and their carbonates, salts of lime and lead.

Physiological Actions.—By assisting digestion and by correcting an abnormal condition of the alimentary mucous membrane, acids directly contribute to the blood-forming process, and indirectly, through the blood, to the construction of tissue, and the bettering, in general, of the bodily condition.

The mineral acids grouped above agree in the general qualities of their actions, but differ in some particulars. They attack the living tissues with great energy, abstract the water, and combine with the potash, soda, and lime bases. In virtue of this affinity for water and this power of combination with bases, they cause destruction of tissue and are called *escharotics.* Some of them are more powerful than others: thus, sulphuric and phosphoric acids penetrate more deeply than the others. Nitric acid stains the skin yellow; sulphuric acid carbonizes or blackens. Hence in cases of accident, or when these acids are used with criminal intent, it is very obvious at a glance which has been taken or given: nitric acid making a yellow stain of the face, lips, and mouth, and sulphuric carbonizing or blackening those parts. In the stomach they produce the same effects. When concentrated, they destroy the mucous membrane of the mouth, epiglottis, œsophagus, and stomach. The systemic effects are those of the irritant and corrosive poisons. The appropriate remedies are chemical and mechanical: alkalies, magnesia, soda, lime, soap, to neutralize the acid; and eggs, milk, oil, etc., to protect mechanically the tissues. The depression of the powers of life which immediately follows the ingestion of a mineral acid should be treated by opium, nutrient and stimulating enemata, and the intra-venous injection of ammonia.

The mineral acids, when administered in medicinal doses, must on reaching the stomach act in accordance with their chemical position. They will combine with the bases and form salts. Hydrochloric, and to a less degree phosphoric, aid digestion, acting as synergists to pepsin, and contribute to the formation of peptones. Sulphuric unites with bases to form insoluble sulphates, and precipitates the albuminous substances from their solution in the gastric juices; hence this acid, although for a brief period it improves, soon disorders digestion. It is true of all the mineral acids that their long-continued use diminishes the production of acid gastric juice, and in this way after a time they cause the very troubles for the relief of which they were originally administered. An acid solution on one side of an animal membrane, and an alkaline solution on the other, is the condition most favorable to osmosis. Hence the introduction of an acid into the stomach with sufficient frequency and in sufficient quantity must impair the production of acid gastric juice. In practice this is found to be the case. The mineral acids are among the most diffusible substances known, and of these hydrochloric stands at the head. So much of these acids as does not enter into combination in the stomach diffuses quickly into the blood, and the salts which they form by combination with bases follow the laws of diffusion according to their class. The acids, especially the hydrochloric, and next nitric, diminish the alkalinity of the blood, and in this way accomplish all that they are capable of doing as systemic remedies.

THERAPY.—Not much need be said of the use of the mineral acids in affections of the mouth and throat. Formerly they were much employed in the treatment of *mercurial* and other forms of *stomatitis, diphtheria, aphthæ, gangrene*, etc.

In using mineral acids in affections of the mouth, it should not be forgotten that they attack the enamel of the teeth. First, the animal matter adherent to the teeth is dissolved off, when the teeth are said to be "set on edge." The acid should be applied to the affected surface only, and the mouth should afterward be washed out with an alkaline lotion. Pure hydrochloric acid may be applied with a camel's-hair brush or on a bit of soft pine-wood to the gums in cases of sloughing from *mercurial stomatitis*, and to the ulcers of *stomatitis materna*, to *syphilitic mucous patches*, and to those painful ulcers of the mouth which occur periodically in some subjects affected with a peculiar form of indigestion. In the case of ulcers having their origin in stomach-disorder, the internal use of hydrochloric, nitric, or nitro-hydrochloric acid, is often extremely beneficial.

The local use of hydrochloric acid in *diphtheria*, so strongly urged by Bretonneau, is now rarely employed, for it is well known that the diphtheritic exudation will rapidly extend over an inflamed surface produced by the application of the acid, and the destruction of the exudation at one part does not prevent its extension and renewed formation.

Any of the mineral acids administered by the stomach should be well diluted, and to prevent injury to the teeth should be taken through a glass tube or a straw. The mouth should also be rinsed out after swallowing the acid.

The mineral acids are highly useful in certain stomach-diseases. In *atonic dyspepsia* hydrochloric acid should be given after meals, or better, lactic acid. It is highly probable that hydrochloric acid is produced during digestion by the reaction between chloride of sodium and lactic acid. A combination of the acid with pepsin, as already suggested, is preferable in these cases of atonic dyspepsia. When, in consequence of faulty digestion, acetic, lactic, and butyric acids are produced in the stomach from the starchy, saccharine, and fatty constituents of the food, the acids given after meals add to the distress of the patient.

To prevent the *excessive formation of acid*, whether due to the action of the gastric glands, or to abnormal fermentation of the starchy, saccharine, and fatty elements of the food, mineral acids are used with decided advantage, but they must be administered before meals. For this purpose, hydrochloric or phosphoric acid is to be preferred. The excessive production of acid is manifested by *acid eructations*, *pyrosis*, *heartburn*, and *ulcerative stomatitis*.

Indigestion characterized by eructations of offensive gas, a sallow complexion, by the appearance of oxalate-of-lime crystals in the urine, accompanied by mental despondency, is relieved by nitro-muriatic acid; better by nitric, when the symptoms of lithæmia are predominant.

The experience of English physicians practicing in India has been favorable to the use of nitro-muriatic acid in *chronic hepatic affections*, and in *dysentery* and *dropsy* of hepatic origin. Acute diseases of the liver, and such chronic affections as *cirrhosis* and *waxy degeneration*, are not as a rule benefited by the mineral acids. *Mucous duodenitis* and *catarrh of the gall-ducts accompanied by jaundice*, and *jaundice of malarial origin*, are forms of hepatic disease in which nitro-muriatic acid is serviceable. With the internal use of the acid should be conjoined the local use to the right hypochondrium of the acid-bath. Three ounces of nitro-muriatic acid to a gallon of water is a suitable strength for the topical use in this way. The feet may be placed in the bath, and the legs, arms, and abdomen may be alternately sponged, when the skin is torpid and its secretion defective. The temperature of the bath should be about 96° Fahr. (Martin). Another mode of making topical application of the acid bath is as follows: "Let a flannel roller of ten or twelve inches wide, and sufficient to encircle the body twice, be soaked in the fluid and then wrung so as to remain only damp. Apply this instantly to the body, covering it with a piece of oiled-silk to avoid damping the dress. It should be worn constantly, but should be changed, soaked, and wrung, morning and evening" (Squire). This is a very effective local application in the hepatic disorders mentioned above as amenable to treatment by the mineral acids, and is serviceable in the first stage of cirrhosis. Dr. Scott, of Bombay, ascribes to the acid bath the power to relieve the pain of hepatic colic, by causing the expulsion of the impacted calculus.

The mineral acids are very effective remedies in the treatment of *summer and colliquative diarrhœa.* Crapulous diarrhœa and dysentery are not benefited by them. The indications for their use are these: painless, watery evacuations, of a light color, alkaline in reaction. Hope's mixture, which contains nitrous acid, has long been used with success in such cases. The formula is as follows: ℞ Acidi nitrosi, ʒ j; tincturæ opii, gtt. xl; aquæ camphoræ, ℥ viij. S.: One fourth to be taken every three or four hours. A mixture of this kind may readily be extemporized, in which the relative proportion of the acid and opium may be arranged according to the indications of the case. Sulphuric acid is more decidedly astringent than nitric and muriatic, and is, therefore, as a rule, to be preferred in diarrhœa. Bence Jones places them as regards their actions thus: Hydrochloric more promotes digestion; nitric acid, secretion; and sulphuric, astringency. Nitric and nitro-hydrochloric are, according to this view, better suited to stomach and hepatic disorders characterized by deficient secretion, and sulphuric is more appropriate for the relief of a relaxed state of the mucous membrane. A combination of aromatic sulphuric acid with opium is one of the most effective remedies we possess in the treatment of *summer diarrhœa* and *cholera.* Sulphuric acid may also be used with advantage in the treatment of *dysentery,* in combination with sulphate of magnesia. ℞ Magnesii sulphat., ℥ j; acidi sulphur. dil., ʒ ij; morphinæ sulph., gr. j; aquæ, ℥ iv. M. S.: A tablespoonful every three or four hours. After the action of a saline laxative, Hope's mixture, or an extemporized prescription of a similar kind, may be used. When the mineral acids do not quickly improve the discharges and lessen their frequency, and when they increase the tormina and tenesmus, they should be suspended. In the treatment of cholera, dilute or aromatic sulphuric acid may be given frequently, well diluted, in full doses. Opium can be added at such intervals as may be indicated. MacCormac has found the acid to be a most valuable prophylactic against cholera attacks. It should be administered with promptness when the preliminary diarrhœa is threatened.

Mineral acids, especially the muriatic, are very serviceable in *fevers*. They were formerly classed as refrigerants, or cooling medicines, and were supposed to allay thirst and to diminish fever. Although these notions are no longer entertained, the acids are known to render an important service in fevers. They increase secretion of the mucous membrane, and thus relieve the dryness of the tongue and fauces. As in fevers the gastric juice is deficient in acids, digestion is materially aided by their administration. In typhoid fever, the acids restrain somewhat the exhausting diarrhœa, increase the digestive power, remove or diminish the dryness of the tongue, and, it may be, destroy the microbes, which constitute the poison of typhoid, or which produce it under circumstances favorable to their development. Hydrochloric acid is preferable in the treatment of fevers. It may often be advantageously administered in beef-juice.

In *scarlet fever*, hydrochloric acid is frequently combined with chlorate of potassa (producing euchlorine), but it is better administered alone in this disease. Besides the internal administration of the acid, it is often mixed with water and used as a gargle, or mixed with honey and applied with a brush to the throat. One part of acid to five parts of honey or ten of water is a strong enough solution for this purpose. In the other *eruptive fevers*, hydrochloric acid is serviceable to allay thirst, to increase digestion, and to obviate the tendency to adynamia in these diseases. To children, the dilute hydrochloric acid may be readily administered in lemonade or in sirup of lemons.

There is no doubt of the value of the acids, especially the nitro-muriatic, in the treatment of *constitutional syphilis*. This remedy is not to be compared in efficiency with mercury and iodide of potassium, but in chronic cases saturated, so to speak, with these approved remedies, in which syphilitic patches persistently reappear in the mouth, nitro-muriatic acid often renders important service. It is undoubtedly true that constitutional syphilis has been treated successfully by the acids alone, but a very rigidly abstemious dietary has been enforced in these cases. It has already been shown that the denutrition method is of itself sufficient in some cases to relieve the organism of constitutional infection. How much of the result is to be ascribed to the remedy, and how much to denutrition, is not clear.

Nitric acid has been used with success in the treatment of *intermittent fever* by Hammond, Bailey, and others. In order to obtain a curative effect, it is necessary to give the acid in full doses every four or six hours. This acid is of great service, also, after an arrest of the paroxysms of intermittent by quinine, to remove the hepatic congestion and the changes in the glandular apparatus of the intestines induced by the fever-movement. It may be advantageously combined with the bitters, or used instead of the aromatic sulphuric acid in the preparation of the official *infusum cinchonæ flavæ.*

The mineral acids have long been used with more or less advantage in the treatment of *phthisis.* Their utility obviously depends on the fact that they supply to the digestive fluids a material in which they are deficient in this disease. As Fenwick has shown, both pepsin and acid occur in quantity much less than normal in the gastric juice of phthisical subjects. The acid best suited for the treatment of the *indigestion of phthisis* is the official *acidum muriaticum dilutum.*

Nitric acid is one of the numerous remedies used in *whooping-cough.* It is frequently successful in shortening the duration of the disease and moderating its violence; but it acts much more beneficially after the subsidence of the catarrhal stage. It should be given well diluted in sweetened water. *Chronic bronchitis* and *hoarseness produced by singing and by simple acute catarrh* are relieved by ten-minim doses of dilute nitric acid.

The mineral acids, especially the hydrochloric, have lately been proposed as remedies for *acute rheumatism.* The unquestionable utility of the tincture of the chloride of iron in rheumatism lends support to this practice. It is highly probable that the mineral acids check the formation of lactic acid in the blood. Whatever may be the nature of the action, good results from the treatment have been reported (Dr. J. James Ridge).

Some of the accidents due to *lead* are prevented, and relieved when they occur, by sulphuric acid. Sulphuric-acid lemonade is used by workmen in lead-factories to prevent lead-poisoning. This is supposed to act by forming the insoluble sulphate of lead. Dilute sulphuric acid is also effective in the treatment of *lead-colic.* The *constipation due to lead* is relieved by a combination of sulphuric acid and sulphate of magnesia, and the lead-cachexia is much benefited by a prescription of sulphate of quinine, sulphate of iron, and dilute sulphuric acid. The effects of lead on the nervous system are not removed by sulphuric acid.

Sulphuric acid is sometimes very effective in *uterine hæmorrhage.* It has seemed to the author to be more useful in the case of hæmorrhage due to fibroid or polypus than the flow arising from other causes. Although sometimes prescribed for *pulmonary hæmorrhage,* it is not equal to other remedies. In *intestinal hæmorrhage* sulphuric acid acts directly in part, and is therefore serviceable. In *purpura* it sometimes acts happily.

The aromatic sulphuric acid has long been used to check *profuse sweating,* especially the *sweating of phthisis.* It is certainly serviceable in this condition, but objectionable because of the ill effects of the acid on the function of digestion. If used at all, it should not in any case be long continued.

Nitric and nitro-hydrochloric acids have also been used with advantage in such diseases of the skin as *lepra*, *impetigo*, *acne*, *erythema nodosum*; and sulphuric, internally and locally, is said to be very effective in *lichen*, *prurigo*, and itching conditions in general.

In certain morbid states of the urine, as the *phosphatic diathesis*, *oxaluria*, *alkalinity of the urine from disease of the urinary mucous membrane*, and *phosphatic calculus*, the mineral acids render important service. In chronic cystitis and phosphatic deposits, a very weak solution of nitric acid (gtt. j—℥j) may be injected with advantage. In using such injections it is to be remembered that the bladder is extremely intolerant, and hence they should be permitted to escape immediately. When *uric acid is in excess* in the urine from faulty digestion and assimilation, nitric acid is often of great service: the excess of uric acid disappears because the foods are more perfectly prepared for admission into the blood.

Local or Topical Uses of the Mineral Acids.—Some allusions have been made to the local application of muriatic acid in diseases of the throat and of the acid bath in hepatic affections. It will not be necesary to recapitulate on these points.

Nitric acid is one of the most efficient escharotics for the destruction of specific or unhealthy ulcers. It is the most frequently used caustic for the destruction of *chancroid*, *sloughing* or *phagedenic chancre*. A glass rod or bit of pine is dipped into the acid and applied, care being taken to penetrate to all the sinuosities of the sore. The surrounding healthy tissue may be protected from injury by the previous application of oil, and, when the acid has sufficiently penetrated, its further action may be arrested by some alkaline wash. A water-dressing, or spirit and water, or dilute tincture of benzoin, or some similar application, may be afterward applied to the sore. Ordinary indurated chancre does not require escharotic applications. *Hospital gangrene*, or a *gangrenous condition* of wounds, injuries, or ulcers, is similarly treated with advantage, and probably no form of caustic is more desirable than nitric acid for these purposes. Ordinary *torpid* and *ill-conditioned ulcers* are improved and put in the way of healing by frequent washing with a weak lotion of nitric acid (℥j—Oj). The same solution will remove *mucous patches* and *condylomata*, and will often check the bleeding from *hæmorrhoids*.

Nitric acid is one of the means employed for the removal of *hæmorrhoids*. It is not effective, however, against all forms. Large hæmorrhoids are much better treated by the ligature, galvano-caustic loop, or carbolic-acid injections. The so-called "strawberry-pile," a small hæmorrhoid of red color, which consists of a congeries of arte rial twigs and which bleeds freely, can be effectually destroyed by nitric acid. The pile should be exposed, usually through a speculum, and the strong nitric acid be applied on a pine stick freely, followed by an abundant application of olive-oil to prevent the extension of the escharotic action to the surrounding parts. Small, superficial *nævi* are treated successfully in the same way.

Sulphuric acid penetrates more deeply than nitric, and its escharotic action is not so easily limited; hence, it is not so frequently employed for the destruction of sloughing and ill-conditioned ulcers. It is sometimes used in the form of Ricord's paste to chancres, sloughing or phagedenic. The paste is made by the addition of sufficient charcoal to strong sulphuric acid to give it the proper consistence. This is spread on a piece of muslin of a size equal to the sore, and is allowed to remain on until an eschar is produced, when an ordinary poultice may be applied.

A favorite liniment of Sir Benjamin Brodie for counter-irritation of diseased joints is made by the addition of sulphuric acid to olive-oil (ʒ j of the acid, ℥ iv of olive-oil).

A general bath in, or sponging the body with, a solution of nitromuriatic acid—one ounce to a gallon—is very serviceable in the case of cachectic children who present these symptoms: a dry and wrinkled skin, sallow complexion, capricious appetite with a taste for dirt-eating, and whitish, pasty motions. Applying to the surface of the body an acid solution, must affect the constitution of the blood, for an acid solution on one side of an animal membrane and an alkaline fluid on the other are the conditions most favorable to diffusion.

Lately, Dr. Lombe Atthill, of Dublin, has called attention to the "use of nitric acid in the treatment of uterine disease." He applies the fuming nitric acid to the interior of the uterine cavity after previous dilatation with sponge or laminaria tents. In order to protect the cervix and cervical canal he introduces an intra-uterine speculum with expansive blades. The cavity is first mopped out and dried with cotton; then a probe, wrapped with cotton, is dipped in fuming nitric acid and applied thoroughly to the mucous membrane. This practice is very effective in the treatment of intra-mural fibroids and fungous granulations, to restrain hæmorrhage, and after the removal of polypi. He almost invariably employs nitric acid in the treatment of granular cervicitis and endo-cervicitis, "with the best results." When decided tenderness of the uterus exists, he advises that this be first removed by suitable measures.

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OILS AND FATS.

Adeps.—Lard. *Saindoux*, Fr.; *Schweineschmalz*, Ger.—Below the temperature of 86° Fahr. a soft solid.

Adeps Benzoinatus.—Benzoinated lard. Lard, 1,000 grm.; benzoin, 20 grm.

Adeps Lanæ Hydrosus.—Hydrous wool-fat. The purified fat of the wool of the sheep (*Ovis aries*, Linné) mixed with not more than 30 per cent of water.

Sevum.—Suet. *Suif de mouton*, Fr.; *Schöpsentalg*, Ger. The prepared suet of *Ovis aries.*

Oleum Amygdalæ expressum.—Almond-oil. *Huile d'amandes*, Fr.; *Mandelnöl*, Ger. The fixed oil obtained from the kernel of the fruit of the *Amygdalus communis.*

Oleum Theobromatis. — Cacao-butter. *Beurre de cacao*, Fr.; *Cacaobutter*, Ger. The concrete oil of the kernels of the fruit of *Theobroma cacao.*

Oleum Olivæ.—Olive or sweet oil. *Huile d'olive*, Fr.; *Olivenöl*, Ger. The fixed oil obtained from the fruit of *Olea Europæa.*

Oleum Gossypii Seminis.—Cotton-seed oil. A fixed oil expressed from the seed of *Gossypium herbaceum*, and subsequently purified.

Composition.—Lard is composed of 38 per cent of stearin and margarin and 62 per cent of olein, and olive-oil of 72 per cent of olein and 28 per cent of margarin. The more solid fats, as suet, contain much stearin. These neutral fats are, chemically, combinations of an acid (stearic, palmitic, margaric, oleic) with a base, glycerin.

Petrolatum—[Vaseline; cosmoline].—A semi-solid substance, consisting of hydrocarbons, chiefly of the marsh-gas series. A yellowish, or yellow, fat-like mass, transparent in thin layers, completely amorphous, tasteless, and odorless; insoluble in water, scarcely soluble in alcohol, but readily soluble in ether, chloroform, oil of turpentine, etc.

Oleum morrhuæ.—Cod-liver oil. *Huile de morue*, Fr.; *Leberthran*, Ger. A fixed oil obtained from the fresh-livers of *Gadus morrhua*, or of other species of *Gadus.*

Composition.—Cod-liver oil contains a peculiar principle, *gaduin*, and yields, by distillation with ammonia, *propylamin.* It also differs from the fats and oils above described in containing various biliary principles and traces of iodine, bromine, phosphorus, sulphuric and phosphoric acids, lime, magnesia, soda, and iron. It agrees with the other oils in being composed for the most part of olein and margarin. It is the latter constituent which gives the white cloudiness of cod-liver oil in cold weather, and which is, by the "British Pharmacopœia," directed to be separated by artificial cooling. According to Winkler, cod-liver oil does not yield glycerin, but oxide of propyl, when saponified. There are three varieties of oil, due, not to differences in composition, but to modes of preparation: the *pale*, the *light-brown*, and the *dark* oil. The pale oil is freest from the products of decomposition and empyreuma, is the best for internal administration, and is the official preparation.

In order to obtain more positive therapeutical results, certain medicinal substances are frequently added artificially to the cod-liver oils of commerce. Iodine, bromine, phosphorus, and iron, are thus added. Not only are such compounds bad, chemically considered, but the addition of such ingredients gives great opportunities for sophistication, and impure brown and other fish-oils may be substituted for the pure cod-liver oil. Besides, these combinations possess no therapeutical advantage.

It has been supposed that any oil or fat, even glycerin, may be used in place of cod-liver oil, and cream has been prescribed in this belief. Linseed-oil has been considered to have some special efficacy in wasting diseases, more particularly in phthisis, because of the large amount of vegetable albumen which it contains. These notions are erroneous. Cod-liver oil has special therapeutical virtues because it contains gaduin, propylamin, the constituents of bile, iodine, phosphorus, bromine, etc., in addition to the ordinary ingredients of an animal fat.

PHYSIOLOGICAL ACTIONS.—An oil or fat applied by friction to the epidermis will disappear, and, as a positive gain may thus accrue, it is reasonable to suppose that not only absorption, but assimilation, also, has taken place.

Fat plays an important part in the metamorphosis of animal fluids. As was long since shown by Lehmann, a small quantity of fat is essential to the digestion of nitrogenous articles of food. Cod-liver oil, as well as other oils, when taken in the proper quantity, has the power to facilitate gastric digestion, and therefore promotes the appetite. Oil is a very important material in intestinal digestion—constitutes the molecular basis of the chyle, which consists chiefly of finely-divided fatty matter, each globule of fat being surrounded by a thin layer of albumen. The fat taken in with the food undergoes the emulsionizing process, chiefly in the small intestine, and by the aid of the pancreatic and biliary secretions. Cod-liver oil is, above all other fats, adapted to form the molecular basis of the chyle. All fats do not penetrate into the veins and lacteals with the same facility, and the presence of certain substances is necessary to the process. Fats are not crystalloidal but colloidal substances, and have, therefore, but a feeble power of osmosis ; but, notwithstanding this fact, the blood of the portal vein is much richer in fat than the blood of the arteries and systemic veins. The diffusion of fats is accomplished by the action of the bile. It was long since shown, by Wistinghausen, that in capillary tubes moistened by bile, oil will rise much higher than in tubes not so moistened, or when moistened with water or a saline solution. He also showed that oil will pass through membrane saturated with bile much more readily than through similar membrane saturated with water. It has been ascertained that, in dogs with biliary fistulæ, the amount of fat in the chyle is much below the normal, and in the fæces much greater than normal (Day). Hence it must be concluded that the presence of bile is necessary to the absorption of fats, and that cod-liver oil must be peculiarly adapted to form the molecular basis of the chyle. It is for these reasons that, during a course of cod-liver oil, the body-weight is increased, the red blood-globules become more numerous, and a greater amount of fat is deposited in the tissues. It promotes the constructive metamorphosis. The important *rôle* performed by the oils and fats in the organism is shown by a variety of considerations. Wherever tissue-changes, physiological or pathological, are taking place, fat accumulates and enters largely into the formation of the resulting products. Newly-formed plasma contains much free fat, and all plastic exudations more than the non-plastic (Lehmann). Fat is the most abundant constituent of pus.

Food is intended ultimately for two objects : first, to build up the tissues in the growing state and to reconstruct the tissues wasted by use ; second, to supply force, nervous, muscular, and digestive, to the different parts of the organism requiring it. The part performed by the fats is important as regards both objects. As already stated, they are essential to the construction of tissue ; modern researches have shown that they have a necessary office in the evolution of force. The well-known experiment of Fick and Wislicenus demonstrated that, on a diet of hydrocarbons, great muscular effort can be undergone with but little destruction of muscular tissue, and without increased urea-discharge. Turkish porters, who are remarkable for their great muscular strength and endurance, live on a diet composed of fat and rice. The acrobats of Japan, who live on a similar diet, grow to an enormous size, and accomplish feats of strength and agility to which the athletes of Western nations are hardly equal.

If a muscle is made to contract under a bell-jar, an extraordinary evolution of carbonic-acid gas takes place, just as in violent muscular exercise the amount of carbonic-acid gas exhaled from the lungs is increased.

THERAPY.—Oils and fats are used by inunction in the treatment of the *scaly skin-diseases.* A warm bath, if not contraindicated, may well precede the inunctions, and adeps benzoinatus, or suet, be then thoroughly rubbed in.

Inunctions of oil or fat promote constructive metamorphosis in such chronic wasting diseases as *phthisis, scrofula, chronic dysentery*, etc. The best oil for this purpose is cod-liver oil, but, as it stains the skin yellow and has a disagreeable odor, it is often strongly objected to. Lard or suet benzoinated can be used, or may be perfumed to the taste of the patient. The best time for practicing the inunctions is just before retiring. A warm bath should first be taken, and then from one to two ounces may be rubbed into the skin. A thick night-garment should be put on to promote absorption and to prevent injury to the bedding.

Badly-nourished infants, rickety, or *scrofulous*, or suffering from *chronic intestinal disorders*, who have a dry and scaly skin, are often materially benefited by the tepid or warm bath, followed by inunctions of lard, suet, or almond-oil. *Chlorotic girls*, with or without disorders of menstruation, are improved in condition by the same means. *Spare women*, who wish to gain flesh and roundness of form, may have their wish gratified by warm baths and inunctions of oil. The improvement which results from this practice is partly due to the general gain in bodily nutrition.

Rubeola, scarlatina, roseola, erysipelas, and other febrile diseases, are benefited by oil inunctions. These applications are grateful to the patient; they allay the burning heat of the skin, and in this way diminish restlessness and excitement. Inunctions of oil reduce the temperature, but the decline in fever-heat is in part the result of the calmative influence which these applications have over one of the chief sources of distress. Inunctions of oil have a special utility in the *desquamative stage* of *scarlet fever.* It is the author's observation that inunctions of oil are serviceable in *fevers* generally, when there is much heat of skin and high temperature, with restlessness. Cocoa-butter is the most elegant of these preparations for external use, but lard benzoinated is the best. In the infectious diseases, a little carbolic acid may be added to the inunction oil or fat, with the view of destroying disease-germs.

Those who experience frequent *catarrhal attacks*, and take cold on slight exposure, may have their susceptibility diminished by a daily application of oil to the whole surface of the body.

In many maladies, the patients experience a notable distaste for fatty food in any form. This is especially the case with *scrofulous* and *phthisical* subjects, and, as fat in some form is necessary to digestion, assimilation, and heat-producing, it is obvious that by the use of cod-liver oil an essential element of nutrition may be supplied in the best form. In cases in which there exists a condition of faulty assimilation of fats, cod-liver oil, by reason of the fact that it contains in intimate association the bile elements, is especially adapted to form the molecular basis of the chyle. In *scrofula*, *rickets*, and other disorders of the nutritive functions belonging to this group, cod-liver oil is the best agent for promoting constructive metamorphosis.

After *scarlet fever* in many children, especially in those with strumous diathesis, there occur *discharges from the nose and ears*, *feeble digestion*, and *general emaciation*. These *sequelæ of scarlet fever* are best removed by the internal use of cod-liver oil.

As a remedy in *phthisis*, cod-liver oil holds the first place, but it is not adapted to all forms and all stages of that disease. It is especially a remedy for the chronic forms of phthisis—*fibroid lung* and *chronic tuberculosis*—and is not serviceable in caseous pneumonia and acute phthisis. It is more useful in the chronic forms of phthisis because these afford the time and opportunity to reconstruct the tissues of the body—to build up the tissues from the molecular basis of the chyle. Cod-liver oil is not well borne when there is much fever, and can not be well assimilated when the stomach has undergone the alterations which belong to acute inflammatory affections. This remedy is too often prescribed without any reference to the condition of the patient's digestive functions. The power of the stomach and intestines to digest fat is limited, and, if the quantity which can be disposed of is exceeded, the patient is incommoded. Rarely is it proper to prescribe more than a teaspoonful three times a day, and few patients can digest a tablespoonful. As the secretion of gastric juice, bile, and pancreatic juice, takes place most abundantly during the digestion of food, the time for the administration of oil in phthisical cases is after eating. When it is not well borne, the digestion and assimilation of the oil may be aided by combining it with liquor potassæ, lime-water, the compound tincture of gentian, tincture of nux vomica, or strychnine, or other correctives according to the indications in individual cases. When the oil is not well digested—although stomach disorder may not have occurred—and it is seen to float on the stools, it may be combined with ether, since Bernard has demonstrated that ether increases the production of pancreatic fluid.

If continued for a sufficient length of time, cod-liver oil is of the greatest service in *chronic bronchitis* and *emphysema*. It should be given in the same way and under the same conditions as in phthisis.

Chronic rheumatism and *rheumatic arthritis*, maladies for the relief of which cod-liver oil was first prescribed, when occurring under bad hygienic influences in cachectic subjects, may be much relieved by this agent. In addition to the internal use of the oil, it may be applied with advantage locally to the affected joints. This combined use of the oil, systemically and by local inunction, is to be commended in the so-called *rheumatic gout* with deposits about the joints. On the same principle, cod-liver oil is beneficial in cases of *strumous synovitis*, *caries*, and *necrosis* of bone dependent on a constitutional state.

It does not have, it must be admitted, any direct influence over these morbid processes; but it enters most usefully into constructive tissue-metamorphosis.

As a reconstituent, cod-liver oil is a very useful remedy in certain chronic affections of the brain and nervous system. One of the most common conditions with which we have to deal in middle and advanced life, and also one of the most important as regards the integrity of the brain, is *atheroma of the arteries.* This condition is represented by increased hardness of the radial pulse, the *arcus senilis*, irregular action of the heart, giddiness, vertigo, partial loss of vision, and failure of the memory and other intellectual faculties. Used to obviate these degenerative changes, and to prevent failure in the nutrition of the brain, we have in cod-liver oil a remedy of real value. It should be given in small quantity, and continued for a long time. As a phosphorized fat plays an important part in the structure and functions of the cerebral tissues, we may imitate the processes of Nature and administer the phosphates, the hypophosphites, or the lacto-phosphate of lime, in combination with cod-liver oil. The author has seen excellent results from such a combined use of these agents. Dr. Anstie much insists on the use of fats, especially cod-liver oil, as a part of the diet of those suffering from *neuralgia*, *paralysis agitans*, *epilepsy*, *mercurial tremor*, and *chorea*. Dr. Radcliffe had previously pointed out the utility of fats and oils in the same affections, and all practical physicians familiar with the subject are now pretty well agreed as to the value of this practice. The special indications for cod-liver oil in these affections are faulty assimilation and a low condition of the nutritive functions. Fats and oils are, of course, contra-indicated in these nervous disorders when they occur in plethoric and overfed subjects, but such a state of things is exceptional.

In *diseases of the skin of strumous* origin, cod-liver oil is, as Dr. Tilbury Fox remarks, "our sheet-anchor." Among these diseases are *lupus*, *ecthyma*, *psoriasis*, *scleroderma*, etc. The constitutional state requiring cod-liver oil is a lowered condition of the assimilative functions dependent on the strumous cachexia. The local use of the oil is certainly advantageous in these cases. Dr. Hughes Bennett strongly recommends the free application of the oil to *favus* and *eczema impetiginodes*.

The condition of debility and faulty assimilation which results from the prolonged treatment of *syphilis* with mercury and iodine is frequently remarkably improved by cod-liver oil. The *syphilodermata*, when occurring in cachectic subjects, are benefited by a persistent use of the same remedy. With the internal use of the oil may be conjoined inunctions. These are especially beneficial in the *squamæ* of syphilitic origin.

Mode of Administration of Cod-Liver Oil.—As cod-liver oil is extremely repugnant to many patients, it is desirable to prescribe it in as agreeable a form as possible. It can easily be taken in gelatin capsules containing 20 to 40 minims of oil and a minim or two of guaiacol. Quickly stirred up in a hot whisky-punch, it may be swallowed without appreciation of the taste of the oil. It may be taken on beer, the oil covered with the foam, and carefully prevented touching the glass. A wine-glass may be thoroughly moistened with ale or beer, and the dose of oil just enveloped in the beer, when it may be tossed into the throat without perceiving the taste of the oil; or the oil may be taken in sufficient lemon-juice in the same way. It may also be taken in black coffee. A very good disguise is that of Carlo Paresi, by which it is made to have the odor and taste of coffee. To 400 parts of cod-liver oil are added 10 parts of animal charcoal and 20 parts of ground roasted coffee. The mixture is digested in a water-bath at a temperature of 50° to 60° C., and after standing three days is filtered and put in well-stoppered bottles. It is said that 10 drops of chloroform to 100 grammes of the oil will render it palatable. One part of essential oil of eucalyptus to 100 parts of pale oil makes a mixture in which the odor and taste of the oil are entirely extinguished. Two drachms of cod-liver oil may be mixed with a drachm each of compound spirits of lavender and brandy. Emulsions of cod-liver oil are now prepared with glycerin and yolks of eggs, and suitably flavored. The various emulsions with lime are also much prescribed. Cod-liver oil saponified by lime has been brought forward by Prof. Van den Court, of Brussels, as a remedy of especial efficacy in phthisis. Lastly, cod-liver oil has been used instead of lard or butter in the preparation of rolls, which are readily eaten by children. The addition of ether to cod-liver oil promotes its digestion. Bernard long ago made the observation that ether stimulates the pancreas and increases its secretion, thus contributing to the emulsionizing of the fats. The combination of ether and cod-liver oil has been especially urged by Dr. B. Foster. The committee of the New York Therapeutical Society report that the addition of fifteen minims of ether to each half-ounce of oil enables the patient to take it, if it had previously disagreed.

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PHOSPHORUS AND SOME OF ITS COMPOUNDS.

Phosphorus.—*Phosphore*, Fr.; *Phosphor*, Ger. A translucent, nearly colorless solid, resembling wax, without taste, but having a peculiar smell. Its specific gravity is 1·8.

Oleum Phosphoratum.—Phosphorated oil. Prepared by dissolving phosphorus in ether and almond-oil. One part of phosphorus to 100 parts of the menstruum. Dose, ♏i—♏v.

Pilulæ Phosphori.—Phosphorus pills. Each pill contains about $\frac{1}{100}$ grain. Phosphorus is dissolved in chloroform, and then mixed with powdered althea and acacia, glycerin, and water. The pills are coated with balsam of tolu.

Spiritus Phosphori.—Spirit of phosphorus. Prepared by dissolving phosphorus in absolute alcohol—1·2 grammes of phosphorus and sufficient alcohol to make up to 1,000 c. c. This alcoholic solution is utilized in preparing the elixir of phosphorus.

Elixir Phosphori.—Elixir of phosphorus. Prepared by mixing the spirit of phosphorus 210 c. c. with glycerin 550 c. c. and a sufficient quantity of aromatic elixir (U. S. P.) to make up to 1,000 c. c.

Each cubic centimeter of elixir of phosphorus represents about one fourth milligramme, 0·0025 grain, of phosphorus.

Pills of phosphorus may be extemporaneously made by mixing the bisulphide of carbon solution with some inert powder. The evaporation of the bisulphide leaves the phosphorus in a finely-divided state intimately incorporated with the powder.

Zinci Phosphidum.—Zinc phosphide. Dose, one twentieth to one tenth of a grain. It is best administered in pill-form made with conserve of roses.

Synergists.—Oils and fats favor the absorption of phosphorus, and should never, therefore, be employed in cases of poisoning by this agent. Arsenic, and in a feeble degree sulphur, are synergistic.

Antagonists.—The chief chemical antidotes to phosphorus are hydrated magnesia, lime-water, powdered charcoal, and sulphate of copper. To this list must be added turpentine of a certain kind. Phosphorus is now frequently taken in the form of matches, the particles of which do not readily dissolve in the stomach and intestinal juices. When pure phosphorus, in the sticks or cylinders in which it extremely repugnant to many patients, it is desirable to prescribe it in as agreeable a form as possible. It can easily be taken in gelatin capsules containing 20 to 40 minims of oil and a minim or two of guaiacol. Quickly stirred up in a hot whisky-punch, it may be swallowed without appreciation of the taste of the oil. It may be taken on beer, the oil covered with the foam, and carefully prevented touching the glass. A wine-glass may be thoroughly moistened with ale or beer, and the dose of oil just enveloped in the beer, when it may be tossed into the throat without perceiving the taste of the oil; or the oil may be taken in sufficient lemon-juice in the same way. It may also be taken in black coffee. A very good disguise is that of Carlo Paresi, by which it is made to have the odor and taste of coffee. To 400 parts of cod-liver oil are added 10 parts of animal charcoal and 20 parts of ground roasted coffee. The mixture is digested in a water-bath at a temperature of 50° to 60° C., and after standing three days is filtered and put in well-stoppered bottles. It is said that 10 drops of chloroform to 100 grammes of the oil will render it palatable. One part of essential oil of eucalyptus to 100 parts of pale oil makes a mixture in which the odor and taste of the oil are entirely extinguished. Two drachms of cod-liver oil may be mixed with a drachm each of compound spirits of lavender and brandy. Emulsions of cod-liver oil are now prepared with glycerin and yolks of eggs, and suitably flavored. The various emulsions with lime are also much prescribed. Cod-liver oil saponified by lime has been brought forward by Prof. Van den Court, of Brussels, as a remedy of especial efficacy in phthisis. Lastly, cod-liver oil has been used instead of lard or butter in the preparation of rolls, which are readily eaten by children. The addition of ether to cod-liver oil promotes its digestion. Bernard long ago made the observation that ether stimulates the pancreas and increases its secretion, thus contributing to the emulsionizing of the fats. The combination of ether and cod-liver oil has been especially urged by Dr. B. Foster. The committee of the New York Therapeutical Society report that the addition of fifteen minims of ether to each half-ounce of oil enables the patient to take it, if it had previously disagreed.

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phorus is converted into phosphoro-terebinthinic acid—a spermaceti-like substance, without poisonous or irritating qualities, which is eliminated by the kidneys, the urine having a camphoraceous instead of the violet odor due to turpentine itself. Although the crude French oil is to be preferred, it is probable that our common oil of turpentine, exposed to the air, will develop antidotal power, by absorbing and ozonizing oxygen. The vapor of turpentine acts in the same manner on the vapor of phosphorus. Permanganate of potassium has lately been proved to have complete antidotal power. To accomplish this result, the antidote must be administered before absorption has taken place. The stomach should be evacuated with copper sulphate in solution, and then the stomach should be irrigated with a solution of the permanganate.

To sum up: In the treatment of poisoning by phosphorus, in any of the forms in which it is introduced into the stomach, an emetic of sulphate of copper should be promptly employed, and the bowels should be moved by hydrated magnesia. When the stomach is emptied, small doses of sulphate of copper may be administered, and turpentine given; or a solution of permanganate of potassium may be used. To counteract the cardiac and general systemic depression, opium will become necessary. If phosphorus has entered the blood despite the use of the appropriate antidotes, and much injury to its corpuscular elements has resulted, transfusion can be employed with considerable confidence, since Jürgensen has succeeded in several instances in saving life by this expedient. Direct transfusion of human blood, with or without previous withdrawal of some portion of the damaged blood, is the proper procedure.

Physiological Actions.—The vapor of phosphorus is highly irritating to the conjunctiva and to the broncho-pulmonary mucous membrane. If caries of the teeth exist, necrosis of the maxillary bones may be induced by the vapor; but it is doubtful whether, as has been affirmed, such necrosis may occur when the teeth are perfectly sound. There is an obvious distinction between the local effects of the vapor of phosphorus and the disease of the osseous system, the result of the constitutional impression of this agent.

In ordinary medicinal doses, phosphorus gives rise to a sense of warmth at the epigastrium, but, if the dose be large, decided heat and even burning are experienced, and tenderness of the epigastrium remains. Prolonged administration of full doses will excite considerable gastric disturbance, and a catarrhal state of the mucous membrane. In the process of the oxidation of phosphorus, hydrogen is evolved, which in its nascent state readily combines with a portion of phosphorus, forming phosphide of hydrógen, eructations of which constitute one of the disagreeable features in the administration of this remedy. The action of the heart becomes more frequent, and the cutaneous circulation, especially, more rapid; the body temperature rises somewhat; the mental activity and the muscular power increase; the menstrual flow grows more abundant, and in males aphrodisiac effects are experienced, and the urine and sweat are more abundantly excreted. Phosphorus in small quantity promotes constructive metamorphosis, increases the activity of the vegetative organs, and is a natural excitant of the functions of animal life; it enters largely into the formation of tissues, and is a necessary element in the phosphorized fat which holds an important position in the composition of the cerebral matter. The administration of phosphorus increases the excretion of urinary phosphates.

The effects of phosphorus in toxic doses have been elaborately studied, both in fatal cases of poisoning, occurring in man, and by experiments on animals. The form in which it is swallowed affects the rate at which the action occurs. If taken in solution in oil, in ether, or in the paste used as a vermin-destroyer, the toxic symptoms appear more promptly than if match-heads or ordinary phosphorus has been swallowed. An interval of varying duration elapses from the ingestion of the poison until disturbance of the stomach ensues. This interval—one to three hours—is occupied by the solution and oxidation of the phosphorus. Then epigastric uneasiness, nausea, and vomiting, come on; first, the contents of the stomach, and then mucus and bilious matters being ejected. The vomiting, accompanied by considerable epigastric pain and tenderness, persists usually for several days, when it assumes a special character, owing to the presence of the so-called "coffee-grounds," or "black-vomit." At first the vomited matters have a distinct odor of phosphorus, and appear phosphorescent in the dark. After several days of vomiting these symptoms disappear, and there may then be more or less hæmatemesis, as well as coffee-grounds, due to erosions of the mucous membrane (Wolfe). The condition of the intestines varies with the presence or absence of phosphorus in their contents. The stools may be simply pasty and grayish from the absence of bile, or they may contain mucus and blood, and appear phosphorescent in the dark. Accordingly, as they may or may not be irritated, will the symptoms be those of constipation, diarrhœa, or dysentery. The very characteristic but not invariable symptom—jaundice—appears on the second to the fifth day after the reception of the poison. It is absent in one fourth of the cases, and may be absent, also, when there is considerable fatty degeneration of the liver (Wolfe, Alter). It presents the usual appearance of jaundice as it occurs in acute yellow atrophy. It does not attain the maximum at once, but it appears first as some yellowness of the conjunctiva, the urine also becoming dark and loaded with urates, at the same time.

The chemical changes which phosphorus undergoes in the stomach, and the combinations by which it enters the blood, are as yet not fully explicable. That some phosphoric acid and phosphide of hydrogen are formed is certain. That the oil or fat in the stomach will dissolve some portion of the phosphorus, and thus facilitate its diffusion as phosphorus into the blood, is highly probable (Husemann and Marmé). Phosphorus is also slightly soluble in water at about 100° Fahr., and in organic fluids, as the bile, to a greater extent (Hartmann). As in the oxidation of phosphorus, phosphorous and phosphoric acids, and phosphide of hydrogen, are products, it is certain that these exert a poisonous influence to a greater or less extent in the stomach (Lecorché). A portion of the agent taken undoubtedly enters the blood as phosphorus, and the subsequent changes in tissue-metamorphosis are due to its presence in the blood, where it has been detected by Bamberger and others. With the entrance of the poison into the blood the action of the heart increases, and the temperature rises, the fever having a remittent type (Mannkopff). Toward the end, however, the function of hæmatosis and of tissue-metamorphosis are so depressed that the body-heat declines below normal. In other cases there is no fever at all, or it appears near the end. Very great weakness of the heart's action has usually been observed, and the pulse has been much accelerated, although in some instances it became very slow, descending as low as 40. The damage done to the blood is shown in the hæmorrhages which take place from the various mucous surfaces—from the nose, stomach, intestines, kidneys, uterus (menorrhagia and metrorrhagia)—and into the areolar tissue, in the form of petechiæ and ecchymoses. A hæmorrhagic diathesis develops, so that the bleeding from a simple wound, a leech-bite, etc., may become uncontrollable.

The intellect may remain unimpaired, but usually there are restlessness, with coma, sometimes noisy delirium, anæsthesia of the extremities, paresis of the members, and, near the end, convulsions (Hermann).

The poison entering the blood is eliminated chiefly by the kidneys. The changes occurring in the urine are of especial interest. No departure from the normal occurs until the alterations in the composition of the blood, and the general steatosis, prepare the way. The urine is diminished in amount, contains albumen, blood, and sometimes fibrinous casts. When jaundice comes on, its appearance is first announced by the presence of bile-pigments and acids. Urea almost entirely disappears toward the fatal termination ; leucin and tyrosin are occasionally present, and a peptone-like substance ; but the peculiarity most distinctive is the large quantity of paralactic acid, especially in the fatal cases (Schultzen and Riess).

The duration of the cases of phosphorus-poisoning is by no means uniform. Although the rule is that symptoms do not follow immediately on the entrance of the poison into the stomach, there are cases in which pain, nausea, and vomiting do occur almost immediately, and the most formidable symptoms come on promptly. One case is reported in which death occurred within nine hours, and numerous cases have terminated in death at the expiration of forty-eight to seventy-two hours. But usually the cases are less acute, and death does not occur before the end of the first, second, or third week. It is important to bear in mind that death may take place unexpectedly, before the most severe symptoms manifest themselves (Naunyn); and that the absence of decided gastric disturbance does not necessarily indicate a mild case. When recovery takes place, the improvement is slow, and the duration more or less protracted. In cases observed by Schultzen, the swelling of the liver could be distinguished at the expiration of four weeks, although the jaundice and the hæmorrhages had disappeared.

The changes induced by phosphorus are eminently characteristic. In the stomach are found erosions of variable extent, often absent; fatty degeneration of the epithelium; and a gastro-adenitis, first described by Virchow, and confirmed by subsequent observers, notably by Bernhardt, whence the membrane has a swollen, grayish, or yellowish color. The same state of the mucous membrane may exist in the intestine as well. The liver is much enlarged as a rule, but may be atrophied. In five of the sixteen cases studied by Wolfe the liver was atrophied, but this is probably a more advanced change, and is, therefore, encountered in the most protracted cases. The color of the liver is usually a pale yellow, or it may present a deep yellow, the acini appearing enlarged and distinct. The increased size of the organ, and the change in its appearance, are due to fatty degeneration of the hepatic cells and epithelium (Mannkopff); but, according to some other authorities, an interstitial hepatitis is also set up, which is especially well marked in chronic phosphorus-poisoning. The jaundice, it is agreed generally, is due to resorption of the bile, swelling of the bile-ducts and of the orifice of the ductus communis preventing the entrance of the bile into the intestine. The presence of bile-pigments and acids in the urine supports this view, but it has also been maintained that the jaundice is hæmatogenic from dissolution of the blood.

The changes in the composition of the blood are numerous and important: it is fluid, non-coagulable, its corpuscles altered in form, and it contains much fat (Méhu). There are numerous ecchymoses, especially under the peri- and endo-cardium (noted in thirteen out of sixteen cases by Wolfe), under the capsule of the liver, and in other situations. Besides the alterations in the blood, the occurrence of ecchymoses is favored by fatty degeneration of the small blood-vessels and capillaries (Klebs). The heart is also the seat of an acute fatty degeneration, and its tissue is soft and easily torn. The spleen is enlarged, and the kidneys are also enlarged and fatty, the renal epithelium being crowded with oil-drops.

Not every case exhibits the wide-spread changes above described. If death occur in a short time, within nine hours, as has been noted, not sufficient time will have elapsed to allow of universal steatosis. There may, indeed, be no characteristic morbid appearances under such circumstances. In other cases, the changes may be limited to the liver.

Chronic poisoning by phosphorus presents some interesting features. It occurs in those who are exposed to the vapor, in workmen engaged in phosphorus-factories, and especially in the workers in match-factories. Irritation of the bronchial mucous membrane, and to a less extent of the gastro-intestinal, takes place, with the attendant symptoms of cough, loss of appetite, indigestion, constipation, failure of nutrition, etc. The most important change is that occurring in the maxilla, more especially in the inferior maxilla, which is both more severely and more frequently diseased. The lower jaw has been repeatedly removed for this phosphorus necrosis, which begins in carious teeth, develops into a periostitis, and ends in death of the bone. The alveolar process only, or a part or the whole of the bone, may be cast off. Phosphorus increases the production of osseous tissue ; the spongy tissue is thickened, and the compact is rendered more dense. Extensive osteophytic formations take place in animals fed on it, and the marrow cavity of long bones may be much encroached on, even closed, by the deposit of new osseous material (Wegner).

THERAPY.—The author enjoins on his readers the necessity for caution in the use of phosphorus. As this agent so readily induces an acute fatty degeneration, when taken in poisonous quantity, the propriety of its administration in large doses for long periods may be questioned.

Phosphorus is indicated more especially in the nutritive failure of the osseous and nervous structures of the body. It is especially in nutritive failure of the osseous and nervous tissue that phosphorus is required. The original suggestion by Wegner of its probable utility in *osteomalacia*, or softening of the bones, has been acted on by Friese, who found it remarkably beneficial in some obstinate cases. It will prove useful, also, when this condition exists in *rickets*. That hitherto incurable malady—*progressive pernicious anœmia*—has in some instances been apparently arrested by the administration of phosphorus ; but it has failed in others. The observations of Fox, Broadbent, and others, as to the utility of phosphorus in *lymphadenoma*, are very encouraging, the more especially as, hitherto, remedies have had little influence over this intractable malady.

The physiological action of phosphorus in small doses in increasing mental activity finds a therapeutical expression in the use of its preparations in cerebral disorders. It is indicated in pathological states dependent on anæmia, and contraindicated in vascular congestion and excitement. Cases of *wakefulness*, dependent on cerebral anæmia and exhaustion, are often remarkably benefited by phosphorus in the form of the pill or tincture. It does not procure sleep in the way that chloral and bromide of potassium do. By the use of it in suitable states we supply to the cerebral substance a material which it requires for the healthy performance of its functions. It acts most beneficially in the cases of wakefulness in which the nutritive functions of the body are wanting in activity. The *wakefulness of the aged*, accompanied with muscular cramps, feebleness of memory, giddiness, and trembling of the voluntary muscles on exertion, is improved by the preparations of phosphorus. *Early decay of the mental powers*, associated with atheromatous changes of the cerebral vessels, and consequent impaired nutrition of the brain, is benefited by minute doses of this agent. In these states, occurring in the aged, it is better to combine with the phosphorus, or to administer simultaneously, cod-liver oil. The author has seen good results from such a combination in *paralysis agitans*. Large doses of the medicine in these disorders of advanced life are improper and unsafe. The best results are obtained from the persistent use of minute doses. M. Delpech has obtained excellent results from the use of phosphorus in *paralysis*. It is obviously adapted to cases of chronic character in which all acute symptoms have subsided. The paralytic symptoms which accompany *white softening of the brain* (local and circumscribed anæmia) have appeared to the author to be improved by the use of the phosphates, hypophosphites, and lacto-phosphate of lime.

The preparations of phosphorus are very serviceable in *neuralgia*. It is true the late Dr. Anstie, in his work on neuralgia, expresses the opinion that "its utility is not very extensive or reliable." Radcliffe, Bradley, Broadbent, Mr. J. Ashburton Thompson, on the other hand, report cures in some obstinate cases. Mr. Thompson's experience indicates that large doses are necessary to effect a cure. In his own words: "I now invariably begin by giving $\frac{1}{12}$ of a grain every four hours, and this I conclude to be an average dose." The formula given under the title "Tinctura Phosphori" is Mr. Thompson's; each drachm of it contains $\frac{1}{12}$ of a grain of phosphorus. With this solution he has treated successfully thirteen cases of neuralgia. Dr. Broadbent has given phosphorus with advantage in "epileptiform vertigo," neuralgia, and "nervous breakdown from overwork."

We have no remedy at present more efficient in the treatment of *impotence* than phosphorus. In the physiological state, *priapism* is one of the results of its toxic action. It is, of course, adapted only to cases functional in character, and not to impotence from organic defect.

According to Dujardin-Beaumetz, phosphorus is useful in that very protracted and troublesome disease, *progressive locomotor ataxia*, or posterior spinal sclerosis. Although the author has not observed any instances of cure of this affection by phosphorus, he has witnessed in a few instances decided amelioration.

Phosphorus has lately been employed as a substitute for arsenic in the skin-diseases for which the latter is used—notably *acne, psoriasis, lupus.* The author has seen excellent results from the use of the compound sirup of the hypophosphites in *acne indurata.*

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PHOSPHITES AND PHOSPHATES.

PREPARATIONS.—*Syrupus Calcii Lacto-phosphatis.*—Sirup of the lacto-phosphate of calcium. Dose, a teaspoonful. Lactic acid has the property of dissolving freshly-precipitated phosphate of lime.

Compound Sirup of the Phosphates (not official).—Parrish's chemical food. Each drachm contains two and a half grains of phosphate of iron and one grain of phosphate of lime.

Syrupus Hypophosphitum.—Sirup of the hypophosphites. Composed of hypophosphites of calcium, sodium, and potassium. Dose, a teaspoonful three times a day.

Syrupus Hypophosphitum cum Ferro.—Sirup of the hypophosphites with ferrous lactate. Dose, a teaspoonful three times a day.

Sodii Phosphas.—Sodium phosphate. "Large, colorless, transparent, monoclinic prisms, speedily efflorescing on exposure to air, odorless, having a cooling, saline, and feebly alkaline taste, and a slightly alkaline reaction. Soluble in six parts of water at 60° Fahr., and in two parts of boiling water." Dose, one drachm to one ounce.

Sodii Pyrophosphas.—Sodium pyrophosphate. "Colorless, translucent, monoclinic prisms, permanent in the air, odorless, having a cooling, saline taste, and a slightly alkaline reaction. Soluble in 12 parts of water at 60° Fahr., and in 1·1 boiling water; insoluble in alcohol." Dose, half a drachm to half an ounce.

Calcii Hypophosphis.—Calcium hypophosphite. "Colorless or white six-sided prisms, or thin, flexible scales, of a pearly luster, permanent in dry air, odorless, having a nauseous, bitter taste and a neutral reaction. Soluble in 6·8 parts of water at 60° Fahr., and in six parts of boiling water." Dose, gr. ij—gr. x.

Calcii Phosphas Præcipitatus.—Precipitated calcium phosphate. "A light, white, amorphous powder, permanent in the air, odorless, tasteless, and insoluble in water or alcohol." Dose, gr. ij—gr. v.

Sodii Hypophosphis.—Sodium hypophosphite. Small, colorless or white, rectangular prisms, or a white granular powder, having a sweetish, saline taste and a neutral reaction. Soluble in one part of water. Dose, gr. v—gr. x.

PHYSIOLOGICAL ACTIONS.—In the first edition of this work the *phosphates* were included in the same section with *phosphorus*. There is a strong argument in favor of this arrangement, based on the chemical reactions which ensue when phosphorus is introduced into the stomach. Phosphorus has a strong affinity for oxygen, and compounds are quickly formed in the stomach. It is probable, however, that some phosphorus enters the blood uncombined. The toxic activity of the compounds of phosphorus is in inverse ratio to the amount of oxygen contained in the combination. This fact, which would be inferred *a priori*, has been experimentally proved.

PHYSIOLOGICAL ACTIONS OF PHOSPHATE OF LIME.—There is no part of the body which does not contain, or does not yield on incineration, phosphate of lime. It gives solidity to the osseous framework of the body, and, when too little is furnished during the growing period, rickets and *mollities ossium* are the result. The demand made on the system of the mother for the supply of this essential material for the growth of the osseous structure of the fœtus is so great that her fractured bones unite with difficulty. The bones of animals, fed on food deficient in phosphate of lime, soften. All the animal fluids contain this substance in solution : thus it is found in the blood, the saliva, the gastric juice, milk, urine, and in the intercellular fluid throughout the body. It accumulates wherever tissue-changes are rapidly taking place (Dusart). It is obviously very important to the nutritive processes of the body.

As phosphate of lime is to a limited extent soluble in lactic and hydrochloric acids, it is evident that, administered by the stomach, diffusion into the blood must occur. Large amounts can not, however, be disposed of in this way ; hence small doses must be as effective, in the treatment of the maladies for which it is prescribed, as large ones —for all in excess of the quantity soluble in the free acids of the stomach must pass off with the fæces or form intestinal concretions.

PHYSIOLOGICAL ACTIONS OF PHOSPHATE OF SODIUM.—This salt is soluble in water in the proportion of four per cent. Hence it may be given in solution, and will readily diffuse through into the blood. In the dose of one ounce it acts as a laxative. As it has a saline taste similar to common salt, it may be given in soup or other food. It increases the alkalinity of the blood, according to Böcker, by causing a retention of the chloride of sodium. Phosphate of soda diminishes the excretion of urea, in part, it is supposed, by hindering the retrograde metamorphosis of tissue, in part by its interference with the process of digestion. It is a constituent of the blood in the normal state, and as it possesses the remarkable property of increasing the quantity of carbonic acid which can be held in solution by any liquid, obviously we have in these facts an explanation of its influence over the excretion of urea. That it impairs digestion in large doses when administered in health may be admitted, but by removing morbid states of the mucous membrane the digestive function, in suitable cases, is directly promoted by its use, and the nutrition of the body generally, and the tone of the nervous system, improved.

Therapy.—In cases of the so-called *bilious sick-headache*, phosphate of soda is a most useful laxative. A permanent cure of this very troublesome malady may be wrought by regulation of the diet, and by the long-continued use of this remedy. It is not pretended that cases of *migraine*, due to an affection of the nucleus of the fifth, may be thus cured. A large proportion of these cases are produced by a catarrhal state of the gastro-intestinal mucous membrane, which the phosphate of soda has the power to remove. For the same reason, it is a remedy of the highest utility in cases of *jaundice* dependent on catarrh of the bile-ducts, this disease being secondary to the same process in the intestinal mucous membrane. In these affections the phosphate of soda should be administered in a drachm dose (about one teaspoonful) three times a day, or more frequently. Children, who are frequently subjects of this disorder, do not require larger doses than ten grains to a scruple. In preventing inspissation of the bile and crystallization of cholesterin, and attacks of *hepatic colic*, the persistent use of the phosphate of soda is rarely unsuccessful. It is not pretended that this agent can relieve the attacks of hepatic colic, and, indeed, it is useless at these times. Many cases of this disease, if not most of them, originate in a catarrh of the duodenum, the transference of the catarrhal state by continuity of tissue to the gall-bladder, and the formation of a nucleus of mucus and bile, about which the cholesterin crystallizes. Phosphate of soda has the property to prevent the occurrence of these changes, and consequently to prevent attacks of hepatic colic. The author has found one scruple to drachm doses, administered for several months before each meal, extremely efficacious in a number of cases of this kind. The value of Vichy in this and kindred affections probably depends on the phosphate of soda contained in this mineral water.

Many *ill-conditioned children* are found to pass *pasty and white stools*, showing the absence of bile, and are pale and ill-nourished notwithstanding an abundant supply of milk and a vigorous appetite. Ten grains of phosphate of soda, dissolved in the milk and given them several times each day, will often improve the intestinal digestion, change the appearance of the stools, and increase the nutrition of the body.

The phosphates are especially useful in diseases characterized by *mal-nutrition*. In *rickets, mollities ossium, delayed union of fractures, early decay of the teeth in children, caries and necrosis of bone*, in which the phosphate is needed to the repair and growth of the osseous structures, it may be supplied artificially. The phosphate of lime may be administered alone in these states, but is to be preferred in the form of the sirup of the lacto-phosphate, or of Parrish's phosphates. As a large consumption of the phosphate of lime takes place during suckling, the *anæmia of the nursing mother* may be most advantageously treated with the lacto-phosphate of lime or phosphates. The waste caused by *suppuration, carbuncles, mammary abscesses or boils*, may be best repaired by the same means. The constitutional cachexia produced by *chronic bronchitis* with profuse expectoration, *leucorrhœa*, and similar exhausting discharges, may be much improved by the phosphates, and with the general improvement of the bodily state there usually takes place an arrest of the local morbid process.

The explanation of the therapeutical action of the phosphates in the diseases just mentioned is equally true of their use in *phthisis*. The utility of the *hypophosphites* in this disease is not any greater, for it is probably true that these preparations undergo oxidation in the stomach and pass to phosphates. The compound sirup of the hypophosphites is an agreeable preparation and is readily taken, and certainly proves serviceable in the more chronic forms of the disease. The lacto-phosphate, the phosphates, and the hypophosphites, are undoubtedly useful in *chronic phthisis*, *fibroid lung*, *chronic tuberculosis*, *emphysema*, and *dilated bronchi*, but no advantage can be expected from them in acute tuberculosis and caseous pneumonia, and it has been asserted that phosphate of lime—5 grains *ter die*—has the power to stop the sweats of phthisis. If they improve the appetite, promote digestion, and increase the body-weight, they do good; if they disagree with the stomach, they do harm (Bennett). Not unfrequently the sirup of the hypophosphites gives rise to distressing tormina. This may be obviated by combining with it dilute phosphoric acid—a combination very effective, therapeutically: ℞ Syrp. hypophos. comp., ℥ iijss; acid. phosphor. dil., ℥ ss. M. S.: A teaspoonful three times a day. Such a combination may be advantageously given with cod-liver oil, after meals, in chronic phthisis. The addition of arsenic contributes very materially to the therapeutical effects of the lacto-phosphate; for example: ℞ Syrp. calcii lacto-phos., ℥ iv; liq. potassii arsen., ʒ j. M. S.: A dessertspoonful *ter die*.

Late favorable reports regarding the curative effects of phosphorus and its compounds in *pernicious anœmia* have not been confirmed by the most recent experience.

Percy, who has made some useful researches on phosphorus, prepares hypophosphorous acid by passing through a solution of phosphorus in oil, perfectly pure and dry oxygen. He maintains that hypophosphorous acid is the only preparation of phosphorus which should be employed in medicine.

Further experience with the phosphate of soda justifies the author in the expression of his belief that it has the power to retard the growth of the changes known as *sclerosis of the liver*, and possibly, under favorable circumstances, to arrest them and to restore a comparatively normal functional state. When, in obese subjects, a *succession of boils* portends the development of diabetes, this remedy is highly useful especially when combined with the arseniate of soda. It has seemed very beneficial in the hepatic form of *diabetes*. No remedy is more effective in removing that condition of the system which produces *furuncles*, or *boils*.

IRON AND ITS PREPARATIONS.

Ferrum.—*Fer*, Fr. ; *Eisen*, Ger. "In the form of fine, bright, non-elastic wire."

Ferrum Reductum.—Reduced iron. Ferri pulvis. A tasteless powder of an iron-gray color. Dose, gr. ss—gr. ij.

Ferri Carbonas Saccharatus.—Saccharated ferrous carbonate. A greenish-gray powder, odorless, having at first a sweetish, afterward a slightly ferruginous taste. It is only partially soluble in water. Dose, gr. ij.

Trochisci Ferri.—Troches of hydrated oxide of iron. Composition : Hydrated oxide of iron, vanilla, sugar, and mucilage of tragacanth. Dose, one to five.

Ferri Oxidum Hydratum.—Ferric hydrate. Kept in the form of a soft magma and used as an antidote to arsenic.

Ferri Oxidum Hydratum cum Magnesia.—Ferric hydrate with magnesia. (For arsenical poisoning.)

Pilulæ Ferri Carbonatis.—Pills of carbonate of iron. Blaud's pills. Contain ferrous sulphate, potassium carbonate, sugar, althæa, etc. Dose, one to three pills.

Massa Ferri Carbonatis.—Mass of ferrous carbonate (Vallet's mass). Ferrous sulphate, sodium carbonate, honey, sugar, etc. Dose, gr. iij—gr. v.

Mistura Ferri Composita.—Griffith's compound mixture of iron. Composition : Myrrh, sugar, potassium carbonate, ferrous sulphate, spirit of lavender, rose-water. Dose, a tablespoonful.

Emplastrum Ferri.—Iron-plaster, strengthening-plaster. Composition : Subcarbonate of iron, lead-plaster, and Burgundy pitch.

Ferri Hypophosphis.—Ferric hypophosphite. A white or grayish-white powder, odorless and nearly tasteless, only slightly soluble in water.

Ferri Phosphas Solubilis.—Soluble ferric phosphate. In bright-green, transparent scales, freely soluble in water. Dose, gr. ij—gr. v.

Ferri Pyrophosphas Solubilis.—Soluble ferric pyrophosphate. In apple-green scales, having an acidulous, slightly saline taste, and wholly soluble in water. Dose, gr. ij—gr. v.

Ferri Sulphas.—Ferrous sulphate. In transparent, bluish-green crystals, which, on exposure to the air, effloresce and change color. Is wholly soluble in water. Dose, gr. j—gr. iij.

Ferri Sulphas Exsiccatus.—Dried ferrous sulphate. A grayish-white powder, soluble in water with the exception of a small residue. Dose, gr. j—gr. ij.

Ferri Sulphas Granulatus.—Granulated ferrous sulphate. A pale, bluish-green powder ; oxidizes in contact with moisture ; soluble in 1·8 part of water at 60° Fahr. Dose, gr. ij—gr. v.

Liquor Ferri Subsulphatis.—Solution of ferric subsulphate. Monsel's solution. Composition: Sulphate of iron, sulphuric acid, nitric acid. An inodorous, sirupy liquid, of a ruby-red color, and of an extremely astringent taste, without causticity. It mixes with water and alcohol, in all proportions, without decomposition.

Liquor Ferri Tersulphatis.—Solution of ferric sulphate. Composition: Same as preceding preparation, except the quantity of acid. A dark, reddish-brown liquid, nearly devoid of odor, and of an acid and extremely styptic taste.

Ferri Chloridum.—Ferric chloride. In orange-yellow, crystalline pieces, very deliquescent, and wholly soluble in water, alcohol, and ether. Dose, gr. j—gr. ij.

Liquor Ferri Chloridi.—Solution of ferric chloride.

Tinctura Ferri Chloridi.—Tincture of ferric chloride. Composition: Solution of chloride of iron, alcohol. Dose, ♏ v—♏ xx.

Liquor Ferri Nitratis.—Solution of ferric nitrate. A transparent liquid, having a pale amber color. Dose, ♏ ij—♏ v.

Syrupus Ferri Iodidi.—Sirup of ferrous iodide. A transparent liquid of a pale-green color. Composition: Iodine, iron, sirup. Dose, ♏ x—♏ lx.

Pilulæ Ferri Iodidi.—Pills of ferrous iodide. Composition: Iodine, iron, sugar, licorice, and gum arabic. Dose, one to three pills.

Ferri Iodidum Saccharatum.—Saccharated ferrous iodide. Dose, gr. j—gr. v.

Liquor Ferri Citratis.—Solution of ferric citrate. Used in the preparation of *ferri citras* and *ferri et ammonii citras.*

Ferri Citras.—Ferric citrate. "Transparent, garnet-red scales, odorless, and having a very faint ferruginous taste and an acid reaction; slowly but completely soluble in cold water."

Ferri et Ammonii Citras.—Iron and ammonium citrate. In garnet-red, translucent scales, having a slightly ferruginous taste, and readily and wholly soluble in water. Dose, gr. ij—gr. v.

Ferri et Ammonii Sulphas.—Iron and ammonium sulphate. Ammonio-ferric alum. In octahedral crystals of a pale violet color, soluble in one and a half part of water at 60°. Dose, gr. j—gr. ij.

Ferri et Ammonii Tartras.—Iron and ammonium tartrate. In transparent, garnet-red scales, which have a saccharine taste. It is slowly soluble in rather more than its weight of water, but insoluble in alcohol and ether. Dose, gr. ij—gr. v.

Ferri et Potassii Tartras. Iron and potassium tartrate. In transparent scales, of a dark ruby-red color, and wholly soluble in water. Dose, gr. ij—gr. v.

Ferri et Quininæ Citras.—Iron and quinine citrate. In thin, transparent scales, reddish or yellowish brown. Taste ferruginous and bitter. Slowly soluble in cold, more readily in hot water, and not soluble in alcohol and ether. Dose, gr. j—gr. v.

Ferri et Quininæ Citratis Solubilis.—Soluble iron and quinine citrate. Thin, transparent scales, of a greenish golden-yellow color, without odor, and having a bitter, mildly ferruginous taste. Rapidly and completely soluble in cold water. Dose, gr. j—gr. v.

Liquor Ferri et Quininæ Citratis.—Solution of iron and quinine citrate. Contains 6 per cent of quinine.

Ferri et Strychninæ Citras.—Iron and strychnine citrate. Contains one grain of strychnine to 100 grains of the compound. Dose, gr. j—gr. iij.

Liquor Ferri Acetatis.—Solution of ferric acetate.

Tinctura Ferri Acetatis.—Tincture of ferric acetate. A clear, dark, reddish-brown liquid, having the odor of acetic ether, an acidulous and astringent taste, and mixes with water in all proportions. Dose, ♏ x to ʒ ij.

Ferri Lactas.—Ferrous lactate. In greenish-white crystalline crusts or grains, of a mild, sweetish, ferruginous taste, soluble in forty-eight parts of cold water, but insoluble in alcohol. Dose, gr. ij—gr. x.

Ferri Valerianas.—Ferric valerianate; a dark brick-red, amorphous powder, insoluble in water. Dose, gr. ij—gr. v.

Vinum Ferri Amarum.—Bitter wine of iron (soluble iron and quinine citrate, tincture of sweet orange-peel, sirup, and white wine). Dose, a teaspoonful to a tablespoonful.

Vinum Ferri Citratis.—Wine of ferric citrate. Dose, a teaspoonful to a tablespoonful.

Liquor Ferri et Ammonii Acetatis.—Solution of iron and ammonium acetate (Basham's mixture). Contains tincture of ferric chloride, solution of ammonium acetate, diluted acetic acid, aromatic elixir, glycerin, and water. Dose, ʒ j—ʒ ij.

Ferropyrine.—A combination of ferric chloride and antipyrin. It contains 12 parts of iron, 24 parts chlorine, and 64 parts of antipyrine. It is a dry, orange-red powder which is soluble in 5 parts of cold water and 9 parts of boiling water, in alcohol and benzene. The dose ranges from five to fifteen grains in pill, powder, in solution, or wafer. It is employed externally as an antiseptic; internally as an analgesic. It is used in anæmia, migraine, and locally in gonorrhœa. (Unofficial.)

Mistura Ferri Laxans.—Composition: Sulphate of iron, 2 grains; sulphate of magnesia, 1 drachm; dilute sulphuric acid, 3 minims; spirit of chloroform, 20 minims; peppermint-water, to 1 oz. (Squire).

Ferrum Dialysatum.—Dialyzed iron. This preparation is made by the process of diffusion, and is iron in the colloid state. It is odorless, without the styptic taste of the ferruginous preparations, does not blacken the tongue and teeth, is free from irritant action, and does not constipate. It is precipitated by sulphuric acid, by acids, and by various salts, but neither by alcohol nor sugar. It is doubtful whether it be a good form in which to administer iron. Dose, ♏ v—ʒ j. If any given preparation has a styptic taste, and acts on the tongue and teeth, it is not genuine.

Reduced iron is one of the most useful ferruginous preparations for internal administration, comparatively tasteless, and therefore easy of administration, and readily soluble in the juices of the stomach. The objection to its use is the occurrence of eructations, sulphureted or phosphureted, owing to the oxidation of the iron, the evolution of hydrogen, and the combination of the nascent hydrogen with sulphur or phosphorus.

The so-called subcarbonate of iron is really little more than the red oxide. In the official pilulæ ferri carbonatis, the oxidation of the iron and the loss of carbonic acid are prevented by the sugar. This preparation is very soluble in the stomach-juice, and is readily assimilated. The troches of carbonate of iron are convenient for administration to children, who take them readily. The hydrated oxide of iron is solely used as the antidote to arsenic in solution. For remarks on its administration I have to refer the reader to the article on Arsenic. Corresponding to these carbonates are the pilulæ ferri compositæ, which contain iron in the form of the carbonate, sulphate of soda, and myrrh. The mistura ferri composita is also a solution of the carbonate, contains myrrh and sulphate of potash, with a sufficient quantity of the latter to form an emulsion which suspends the iron.

Of the phosphates the better preparation is the pyrophosphate, which is readily soluble, unirritating, and easily assimilable. The sulphate is an active astringent, and is an efficient remedy. When prescribed in pillular form the dried sulphate should be used, as the sulphate in efflorescing destroys the cohesion of the mass. Of the several solutions intended for topical use, the liquor ferri subsulphatis, or Monsel's solution, is the best, as it is powerfully styptic without being corrosive. The tincture of the chloride of iron is most agreeably taken in the form of Creuse's tasteless preparation, which appears to be an efficient chalybeate without possessing the causticity of the pharmaceutical preparation. In the sirup of the iodide of iron and the sirup of the iodides of iron and manganese, sugar is used to prevent oxidation of the iron and the setting free of the iodine. In the iodide-of-iron pill the same result is obtained by sugar or gelatin coating.

Less irritating to the stomach, but probably less efficient as chalybeates, are the combinations of iron with vegetable acids. These may be administered dissolved in Rhine, Catawba, or sherry wine. An elegant mode of prescribing them is in effervescence—the citrates or tartrates dissolved in a solution of citric or tartaric acid, and poured into a solution of sodium or potassium bicarbonate—to be drunk in effervescence.

ANTAGONISTS AND INCOMPATIBLES.—The carbonates are incompatible with acids and acidulous salts and vegetable astringents; the citrates and tartrates with mineral acids, alkalies and their carbonates, tannic acid; the iodides with acids, acidulous salts, alkalies and their carbonates, lime-water, vegetable astringents; the tincture of the chloride, with alkalies and their carbonates, lime-water, carbonate of lime, magnesia and its carbonate, and astringent vegetables turn it black.

SYNERGISTS.—All agents promoting constructive metamorphosis are synergistic to iron, especially animal aliment, the simple, aromatic, and astringent bitters, cinchona, manganese, bismuth, etc.

PHYSIOLOGICAL ACTIONS.—Although metallic iron is inert, yet in the stomach it enters into combination dissolved in the acids, and then acquires molecular activity. As a result of its oxidation in the stomach, hydrogen is liberated, which in its nascent state combines with sulphur, forming sulphureted hydrogen. In part, iron is absorbed by the stomach, probably as an albuminate; in part, in the intestinal canal. The stools under a course of iron become brownish and even black, a result which indicates that a part of the metal taken fails to be absorbed; but, since it has been shown that, whether taken by the stomach or injected into the blood, elimination takes place by the intestinal canal, it remains uncertain how much is excreted or is merely discharged unaltered in the fæces.

Iron is not a substance foreign to the organism. Chemical analysis has demonstrated its constant presence in the blood, in the gastric juice, chyle, lymph, bile, in the pigment of the eye, and in traces in the milk and urine. According to Gorup-Basanez (analysis of C. Schmidt), the blood of man contains one part of iron to 230 of red globules, and that of beef one part of iron to 194 of red globules. Iron exists in combination in hæmatin; according to some in the state of oxide, according to others as metallic iron. That it performs a very important office is shown in the rapid construction of red blood-globules when iron is administered in anæmia. Without it hæmatin is not formed, and the red globules diminish in number. By its medicinal use we furnish to the blood a material which it needs. In health a mixed diet contains sufficient iron for all the purposes of the economy. The blood being improved in quality by the administration of iron, the tissues are better nourished, and all the functions are performed with more vigor.

The physiological action of iron is not limited merely to the construction of red blood. When there is no intolerance to its presence in the stomach, it promotes the appetite and invigorates the digestion. By increasing the disposition for food and the ability to dispose of it, iron acts as a stomachic tonic. Hence, when given in the healthy state, or when administered for too long a period in disease, the gastric glands become exhausted by over-stimulation, and then it is said the iron disagrees. Being a restorative, its use is contraindicated in a condition of plethora, especially when there exists a tendency to hæmorrhage, or when there is reason to suspect an atheromatous state of the cerebral vessels.

In large doses the soluble preparations of iron give rise to nausea and vomiting. Some of them possess more or less toxic activity ; the per-salts are more active than the proto-salts. The iodide and chloride, the nitrate and sulphate, are the most active, death having ensued from the tincture of the chloride in one case (Christison), and alarming symptoms having occurred in others (Taylor).

Certain of the salts of iron, the sulphates, the nitrates, the chlorides, possess a high degree of astringency. Hence they produce constipation when taken internally. Brought into contact with blood, they coagulate it, forming a tough, brownish magma ; and, as the albuminous elements of the tissues are also solidified, they are powerful hæmostatics.

Iron is eliminated by several channels. Its passage down the intestinal canal and exit by this route have already been alluded to. As the experiments of Lussana have shown, a large part of the iron which enters the portal circulation is eliminated by the liver in the bile, and this view is further supported by the recently made investigations of Zaleski, of Dorpat. But a small part of the iron taken, therefore, finally enters the systemic circulation, and of this, the part unappropriated in tissue or blood-globule formation is finally eliminated by the kidneys.

The acid and astringent preparations of iron act on the teeth with considerable energy, as the experiments of Dr. Smith (of Edinburgh) prove.

The tincture of the chloride and the sulphate are more corrosive than the wine, and of course are more injurious than the compounds of iron with the vegetable acids.

THERAPY.—Iron-spray—a weak solution of the liquor ferri subsulphatis (ʒ j—℥ viij)—is very serviceable as an astringent in obstinate cases of *epistaxis*. The nozzle of the delivery-tube of the spray-douche should be inserted just within the anterior nares, and the spray be driven with considerable force. The same application is beneficial in *chronic coryza*, but the objection to its use is the danger of coloring the teeth. In *pulmonary hæmorrhage*, the same application made to enter the throat with the inspired air will often arrest the flow of blood ; and this, notwithstanding so little iron can pass the chink of the glottis.

The subsulphate and pernitrate solutions are the most efficient remedies for arresting *hæmatemesis*. They should be given in small doses—one or two drops, well diluted with ice-water, and frequently. In the absence of these, the tincture of the chloride may be used in the same way. In *intestinal hæmorrhage* the astringent preparations of iron are much less beneficial, if, indeed, they serve any useful purpose —for they are converted into inert sulphides as they descend the canal.

The author has seen the intestinal hæmorrhage of typhoid fever much increased by the rectal injection of a solution of Monsel's salt. The *bleeding from hæmorrhoids* may be much diminished and even arrested by washing the tumors, when they protrude, with the solution of the subsulphate. After the application of the iron, the tumors should be well oiled before returning them into the rectum. The solution of the pernitrate of iron has been very efficacious as an astringent in *chronic diarrhœa and dysentery*, in that known as the army diarrhœa. These diseases, as they occur in civil practice, may sometimes be arrested by this agent, but not usually, in the author's experience. A solution of the tincture of iron is one of the numerous remedies used to destroy the *ascarides vermiculares*—the thread-worms which infest the rectum. As the development of these parasites is favored by the anæmic state, it is good practice to conjoin with any local treatment the internal use of iron, notably the sirup of the iodide.

Iron is frequently given with advantage to promote *appetite and digestion* merely. Indeed, it is the opinion of some eminent authorities that the chief use of iron as a remedy, even in anæmia, is to promote the digestive function. For the purpose of increasing appetite and energizing digestion, the sulphate is the best chalybeate, unless, indeed, the mucous membrane prove intolerant. When digestion is feeble, and the intestinal movements sluggish, it is often advantageous to combine aloes with iron, as in the official aloes-and-iron pill, or with sulphate of magnesia, as in the mistura ferri laxans, the formula for which has been given.

The condition most usually requiring iron is *anæmia*, a deficiency not only of the hæmatin but of the red corpuscles. Iron is given in this state with the view of supplying to the organism a material in which it is deficient, and in this way promoting the construction of the red globules. As, however, food, especially beef, is rich in iron, and as but a small amount of that administered is really assimilated, there is much reason for holding that at least an important function of iron in anæmia consists in its power to promote appetite and digestion. Practical physicians are familiar with the fact that iron improves but little, if at all, the condition of the anæmic, when it does not increase the desire for food and the ability to digest it. In anæmia, iron is given with two objects: to furnish a needed material to the blood; to increase the energy of the primary assimilation. To accomplish the first object, small doses—one or two grains—of reduced iron or of the carbonates, or some one of the combinations with vegetable acids, are most suitable. The second object is best attained by the more active astringent preparations, especially the sulphate and the chloride. Large doses of these are frequently well borne. When they disagree, other salts may be tried, but preference should be given to the most astringent preparation which the patient's stomach will tolerate.

In *chlorosis*, the good effects of iron are not so conspicuous as in anæmia, although they are allied states. During a course of iron in chlorosis, purgatives are now and then necessary. Better results are obtained from a combination of iron and arsenic, and iron and strychnine, than from iron alone. The arseniate of iron is an excellent remedy in chlorosis, but it must be given in larger doses than the posological tables authorize, for it is by no means so actively toxic as is commonly supposed. A good formula is the following: ℞ Ferri arseniat., gr. ij; ext. cinchonæ, gr. xij. M. Ft. pil. no. xij. Sig.: One three times a day after meals.

In anæmia and chlorosis, the iron should be taken after meals to be mixed with the food. The preparations of iron should not be continued too long; occasional intermissions in their use are necessary, otherwise the digestive organs become deranged, and the good effects are lost. Occasional purgation is useful, and acts in a way to favor the absorption and assimilation of the iron. Air and exercise should always, if practicable, be prescribed in a ferruginous course, for the assimilation of iron is directly favored by these hygienic influences.

The *anæmia of chronic malarial poisoning* is especially improved by iron. If enlargement of the spleen and engorgement of the portal circulation co-exist, the use of the compound jalap-powder should precede the iron; or the latter may be combined advantageously with resin of podophyllin, as follows: ℞ Quininæ sulphat., ʒ j; resinæ podophylli, gr. iv; ferri sulphatis exsic., ℈ j. M. Ft. pil. no. xx. Sig.: One or two pills three times a day.

According to some, massa ferri carbonatis is preferable to the sulphate; it is certainly sometimes better borne. ℞ Mas. ferri carbonatis, ʒ j; acidi arseniosi, gr. j; quininæ sulph., ℈ ij. M. Ft. pil. no. xl. Sig.: Two pills three times a day. In *enlarged spleen* of malarial origin, a combination of sulphate of iron with sulphate of quinine is generally preferred. ℞ Quininæ sulphat., ʒ ij; ferri sulphat. exsic., ʒ ss. M. Ft. pil. no. xxx. Sig.: One pill three times a day, or four or five during the day.

Although the preparations of iron are of little service in *leucocythæmia*, they are certainly in a high degree useful in *pseudo-leucocythæmia*, or cachexia of the spleen. In the latter disease the relative number of blood-corpuscles may be greatly reduced, but they can be increased in number and raised to the normal by the use of those materials needed by the blood-making organs, especially by the use of iron.

In *syphilitic cachexia*, the preparations of the iodide of iron possess a high degree of utility. In *sloughing phagedena*, or simple *chancroid*, the iodide is frequently prescribed when these accidents occur in debilitated constitutions. Some authorities prefer the tartrate of iron under these circumstances, but the iodide acts with more promptness and vigor. In the treatment of *constitutional syphilis*, the ferruginous preparations are only useful in so far as they may be applied to promote constructive metamorphosis. More commonly than is supposed by the advocates of special plans of treatment, tonic remedies, especially chalybeates, exercise a most favorable influence over the course and duration of syphilis. ℞ Iodoformi, ℈j; hydrargyri chloridi corrosiv., gr. j; ferri redacti, ℈j. M. Ft. pil. no. xx. Sig.: One pill three times a day. ℞ Iodoformi, chinoidin., ferri redacti, āā ℈j. M. Ft. pil. no. xx. Sig.: One pill three times a day.

Iron is one of the remedies most useful in the treatment of *acute rheumatism*. As was originally suggested by Reynolds, the tincture of the chloride is most serviceable. It is more especially adapted to the treatment of pale, delicate, and cachectic subjects, and is much less beneficial, if not positively harmful, in the plethoric and overfed. Given in suitable cases, the tincture of iron, in doses of ♏ xx—xxx every four hours, diminishes the pain, fever, and sweats, lessens the chances of cardiac mischief, and hastens convalescence. By retarding waste and favoring excretion of uric acid through the kidneys, the duration of the disease is shortened and a tedious convalescence is prevented. We owe to Dr. Anstie the important suggestion that tincture of chloride of iron may be used successfully as a *prophylactic against acute rheumatism*. Here, again, the author must state, as a result of his personal observation, that such prophylactic treatment is very useful in weak and cachectic subjects and not applicable to the robust and full-blooded. The tincture of iron should be administered without delay in such weak subjects with a rheumatic history, when they complain of lassitude, muscular pains, sore joints, furred tongue, although they are yet free from fever and joint-swellings.

The treatment of *erysipelas* by large doses (♏ x—ʒj every four hours) of tincture of chloride of iron is now very generally adopted. It is questionable whether this practice is directly beneficial. Its utility depends chiefly on the support which it affords to the organism while laboring under a debilitating disease, and, as an abundant supply of aliment is prescribed with the iron, it is impossible to estimate in any given case how far the result may be attributable to the remedy.

Influenced by the same considerations, the tincture of iron is frequently prescribed in *diphtheria*, alone or in combination with chlorate of potassa. Although it possesses no special utility in this disease, it may serve as one of the means for maintaining the forces of the body, and in this way indirectly contribute to a favorable result. There is no advantage in applying the tincture of iron to the fauces in diphtheria; it is not a solvent of the false membrane, and can not prevent the spread of the exudation; it is, however, now freely used, and it is said with good results.

In the treatment of *scrofula, strumous enlargement of the cervical,* *inguinal, and mesenteric glands,* and in *rickets,* the preparations of iron occupy a most important place. In these affections the sirup of the iodide of iron is generally preferred, and excellent results are obtained from a combination of phosphate of iron and phosphate of lime, especially in rickets. In these cases, also, the sirup of the iodides of iron and manganese is indicated. Iron is one of the remedies most frequently prescribed in *chronic tuberculosis,* but it has no special influence over the deposition of tubercle. It helps to a better state of the blood-making process, and, by promoting the constructive metamorphosis, hinders the progress of the malady.

As *neuralgia* so often depends on anæmia, it happens that iron is one of the most frequently prescribed remedies for this disease. Anstie prefers large doses (♏ xxx—xl *ter die*) of the tincture of the chloride, and twenty-grain doses of the saccharated carbonate twice or three times a day.

In *disorders of the mind,* either dependent on or increased by an anæmic state, iron is often useful. In *chronic mania* and *melancholia,* when debility is present, iron is employed as a restorative agent. The ferruginous preparations are especially useful in the *anæmic forms of puerperal mania,* and in the *insanity of lactation.* Bucknill and Tuke prefer the tincture of the chloride in these affections.

Iron has been much used in the *epilepsy* of weak and anæmic subjects, but it seems to the author to be more hurtful than beneficial, as a rule, yet he has seen excellent results from a combination of bromide of iron and bromide of potassium in such cases: ℞ Potassii bromidi, ℥ j; ferri bromidi, gr. iv; aquæ, ℥ ij; syrup. simplicis, ℥ vj. M. Sig.: A tablespoonful *bis die.*

Large doses of subcarbonate of iron have long been used with advantage in *chorea.* When the subject of this disease is distinctly anæmic, iron, in some of its forms, is unquestionably serviceable, and its utility is often increased by combination with purgatives. When anæmia is not present, arsenic is preferable to iron. Chorea arising from moral causes (anger, fright, etc.), and from pregnancy, is not benefited by iron. This remedy is especially adapted to the chorea of anæmic girls about the age of puberty.

The preparations of iron are of course inadmissible in acute affections of the respiratory organs, but, in certain of the chronic forms and stages of these diseases, some of the chalybeates are very useful. In *chronic bronchitis,* with free expectoration, the mistura ferri composita has long been used with advantage. At the present time the phosphate of iron, quinine, and strychnine, is generally preferred in *chronic bronchitis,* in the *chronic forms of phthisis,* in *emphysema,* and in *humid asthma.* Iron is contraindicated when pulmonary hæmorrhage exists or is threatened. A combination of tincture of digitalis and tincture of chloride of iron abates the temperature and diminishes the sweats of hectic fever. ℞ Tinct. digitalis, ʒ iij; tinct. ferri chloridi, ʒ v. M. Sig.: Fifteen drops three or four times a day.

In *fatty degeneration of the heart*, the preparations of iron render important service, by improving the nutrition of the organ. The *palpitations*, the *murmur*, and *præcordial anxiety* which accompany cases of anæmia and chlorosis, are relieved by chalybeate medicines. In *dilatation of the cavities of the heart*, especially the right, accompanied by cough, difficult breathing, and general dropsy, greater relief is sometimes experienced from the preparations of iron than by the so-called cardiac sedatives and diuretics. In these cases, as also in *mitral regurgitation*, the distress of the patient increases with increasing thinness of the blood, and is diminished by those remedies, such as iron, which improve the quality of the blood. A combination of iron, digitalis, and squill, is sometimes extremely serviceable in these cases—for example: ℞ Ferri redacti, quininæ sulphat., pulv. digitalis (English), āā ℈j; pulv. scillæ, gr. x. M. Ft. pil. no. xx. Sig.: One pill three or four times a day. Iron may be used with advantage to assist in the process of *compensation in valvular lesions*, when the condition is one of anæmia. Iron is contraindicated in all cases of cardiac disease occurring in those who are full-blooded.

In the passive forms of *hæmorrhage*—in *purpura*, the *hæmorrhagic diathesis*, *epistaxis*, *gastric*, *intestinal*, and *renal hæmorrhage*, when they are due to anæmia or favored by it—iron is unquestionably useful, and the preparation most generally applicable is the tincture of the chloride.

Derangements of the *menstrual function*, when associated with anæmia, more especially when produced by anæmia, are often removed by the use of chalybeate medicines. *Amenorrhœa* is, more frequently than to any other cause, due to anæmia of the ovaries, consecutive to chlorosis or general anæmia, and *dysmenorrhœa* may depend, in one of its forms at least, upon the same condition of the blood. *Menorrhagia* may also be one of the results of an impoverished state of the blood. Iron is the most appropriate medicament in these disorders. It is the judgment of Graily Hewitt and Barnes that "small doses of iron are generally the best" in amenorrhœa. Barnes prefers the solution of the acetate, and speaks favorably of the citrate of iron and ammonia, given in an effervescent state, and of the combination of iron and strychnine. The use of ferruginous preparations in menstrual disorders should be determined by the results of a careful differentiation of the causes. The absence of the uterus and ovaries, occlusion of the cervix, and various other conditions besides anæmia, should be eliminated, and the use of iron restricted to those cases in which an impoverished state of the blood is either the only factor or an influential one.

The injection of the various styptic solutions of iron into the uterine cavity, to arrest *post-partum hæmorrhage*, is now common practice. Notwithstanding the alleged innocuousness of this treatment, it is probable, as Snow Beck has shown, that fatal results have ensued from the incautious use of these injections. The official solutions of the perchloride and subsulphate have been thrown into the uterine cavity, with the effect to cause uterine thrombosis, followed by systemic infection. These solutions are much too strong; one part of Monsel's solution to three of water is sufficiently styptic, and is probably perfectly safe. The uterine cavity should be cleared of clots, and the nozzle of the syringe carried well up to the fundus, when the injection should be slowly delivered. The reader need hardly be reminded that this expedient is only proper after the usual means for securing uterine contractions have failed. The same plan of styptic injections has been used to arrest the *hæmorrhage from abortion*, but caution is necessary in these cases, for it is essential to safety that there be an open and patulous condition of the os, to permit escape of coagula. Similarly these injections are used to restrain bleeding in cases of *uterine fibroids*, *uterine cancer*, and in the *uterine hæmorrhage* dependent on spongy granulation of the mucous membrane. In every case of such use of styptic iron injections, it is essential, first, that air be not pumped into the uterine cavity, and second, that sufficient dilatation of the cervical canal exist to permit ready exit to the surplus fluid and coagula.

In *albuminuria*, connected with chronic changes of the kidney, iron is often very serviceable to improve the digestion, and to correct the anæmia, which is such an obvious feature of these maladies. The tincture of the chloride and the tincture of the acetate—especially the latter—are preferred, partly on account of their value as hæmatinic remedies, and partly because of their supposed diuretic action. When *spermatorrhœa* is dependent upon an impoverished condition of the blood, with relaxation of the vesiculæ seminales, the tincture of iron is useful, but it is rarely of itself sufficient to effect a cure. The chalybeates are only harmful in those cases of *nocturnal seminal losses* which in the robust are merely significant of plethora. In *gleet* occurring in anæmic subjects, and in the *prostorrhœa* and *catarrh of the urethra* which arise from relaxation, the preparations of iron are useful adjuncts to other measures. ℞ Tinct. ferri chloridi, ʒ vj; tinct. cantharidis, ʒ ij. M. Sig.: Fifteen drops in water, three times a day.

The sirup of iodide of iron is one of the most successful remedies in the *nocturnal incontinence of urine* in children. The precise indications for its use are not evident. Sometimes belladonna succeeds better. It appears to the author that the iodide of iron is more useful in the case of pale, delicate, and strumous children, and belladonna in those who are more robust, the condition in the former being one of atony of the muscular wall of the bladder, in the other too ready contraction from the reflex stimulation of acid urine. In these cases of incontinence of urine the sirup of the iodide should be given in doses of fifteen to twenty minims, well diluted with water, three times a day.

LOCAL USES.—The styptic preparations of iron are frequently used to restrain *hæmorrhage*. *Leech-bites* that bleed too profusely, *hæmorrhage after extraction of teeth* or in minor *surgical operations, oozing from a large wounded surface*, may often be checked by the use of Monsel's solution.

As a topical application in *gonorrhœa* after the acute symptoms have subsided, in *mucous cervicitis*, in *leucorrhœa*, the styptic preparations of iron are certainly useful, but a strong objection to their use arises from the staining of the clothing.

Monsel's solution is an effective application to *fissured nipples:* ℞ Liquor ferri subsulphatis, ʒ ij ; glycerini, ʒ vj. M. Sig. : Apply with a camel's-hair brush to affected parts. Pure solution of subsulphate of iron will arrest the growth and cause the exfoliation of *syphilitic vegetations* of the glans and prepuce.

Ferratin.—By this term is meant a proprietary preparation of iron and albumin, the discovery of which we owe to Schmiedeberg and Marfori. It is an organic preparation, and exists preformed in the liver and other parts of animals.

Ferratin is a reddish-brown powder, odorless and tasteless, and contains about 7 per cent of iron. It is not a mechanical mixture of iron salts with albumin, but a genuine chemical combination. The dose ranges from 5 to 15 grains, and is best given in powder, wafer, or capsule. In children it may be suspended in milk. A solution may be made with the aid of sodium bicarbonate, and this presents some advantages in certain states of the stomach and some forms of disease.

Ferratin is a combination of iron of special utility in that it is prepared for assimilation both primary and secondary. It is readily taken and well borne by children and fastidious adults, and as a chalybeate is both prompt and efficient. As it is already in combination with albumin, it is especially adapted to the formation of red-blood globules and should therefore be employed when the relative proportion of them is too low. It has the advantage of all other preparations of iron, that they must be converted into this before being absorbed. In *anæmia, chlorosis, convalescence* from acute diseases, *chronic cardiac* and *renal diseases* with anæmia, and in *nervous affections*, it has been found most effective. That ferratin is taken up in the structure of the blood and tissues is apparent in the fact that no portion of that taken, nor any product thereof, escapes by the kidneys. (Schmiedeberg, Marfori, G. See, and others.)

Hæmol. Hæmogalol.—Kobert has recently brought forward two new preparations of iron, obtained by the action of reducing agents on the blood. They are compounds of iron and albumin—intermediate between hæmoglobin and hæmatin. They are proposed for use in anæmia, chlorosis, in convalescence from acute diseases, and in conditions of depression where a restorative is needed. The dose ranges from 5 to 15 grains. (Kobert, Lang, Weiss, and others.)

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MANGANUM.

Manganese.—*Mangan*, Ger.; *manganèse*, Fr.

Mangani Dioxidum.—Manganese dioxide. Dose, gr. ij—gr. x. In pill or powder.

Mangani Sulphas.—Manganese sulphate. In colorless or pale rose-colored transparent crystals, freely soluble in water. Dose, gr. ij—gr. v.

Unofficial preparations:

Syrupus Ferri et Mangani Iodidi.—A pale straw-colored sirup. Dose, ♏ x—℥ ss.

Ferri et Mangani Carbonas Sacch.—A tasteless, reddish-brown powder. Dose, gr. v—℈j.

Syrupus Mangani Iodidi.—A sirup which corresponds in strength to the official sirup of the iodide of iron, and may be given in corresponding doses.

Besides the above, a carbonate, phosphate, tartrate, malate, and lactate have been proposed for use, but hitherto they have not attracted attention and are rarely employed. The official and unofficial preparations named above are all that, according to the present state of professional experience on the subject, will ever be required. It will be most convenient, however, to include with the manganic preparations the following:

Potassii Permanganas.—Potassium permanganate. In needle-shaped crystals of a deep purple color. It is soluble in sixteen parts of cold water, and the solution has a deep purple to a rose-color, according to the state of dilution of the salt. Dose, gr. ss—gr. ij. In prescribing the permanganate, freshly distilled or boiled and filtered river-water, to free it from organic matter, should be directed.

Physiological Actions.—The sulphate has an extremely disagreeable styptic and metallic taste; the black oxide less so, and the saccharated carbonate is free from any taste except that of the sugar. The preparations of manganese are somewhat irritant to the gastro-intestinal mucous membrane, and the sulphate is emeto-cathartic in full doses. There seems to be no doubt that the sulphate has a decided cholagogue effect, for very large discharge of bile is a result of its cathartic action. In *small* doses the manganic salts promote the appetite and digestive function. They probably enter the blood as albuminates. The intimate association of manganese with iron throughout the economy of Nature is exemplified in the human body. They are found together in the blood, hair, bile, biliary concretions, and renal calculi. The proportion of manganese to iron in the red blood-corpuscles is as one to twenty. As an essential constituent of the blood, it undoubtedly has to do with the constructive metamorphosis of the body. Used in large doses and for a considerable period of time, it produces effects analogous to those of zinc—progressive wasting and feebleness, a staggering gait and paralysis (paraplegia). In toxic doses, according to the researches of Laschkewitsch, it causes in animals death by convulsions. In smaller doses it diminishes the pulse-rate, lowers the action of the heart, and lessens the blood-pressure. Like phosphorus, manganese induces acute fatty degeneration of the liver. When it is injected into the veins of animals, it causes tetanic cramp, dilatation of the pupil, exophthalmus, and death; and after death the heart-muscle does not respond to electrical stimulation (Laschkewitsch).

Antagonists.—The preparations of manganese are not incompatible with the vegetable astringents. The salts of lead, silver, and mercury, and the caustic alkalies, are chemically incompatible with manganese.

SYNERGISTS.—Iron is synergistic as regards hæmatinic effects, and the salts of copper, silver, and zinc, as regards the effects on the nervous system.

THERAPY.—Although manganese has not of itself been very useful in the treatment of *anæmia* and *chlorosis*, yet there is no doubt that its combination with iron much increases the efficacy of the latter. Some of the preparations named at the head of this article, especially the saccharated carbonate of manganese and iron, may be usefully prescribed in these diseases. Cachectic states arising from *syphilis*, *cancer*, *struma*, *gout*, *prolonged suppuration*, *chronic malarial infection*, etc., are advantageously treated by the sirup of the iodide of iron and manganese.

Gastrodynia and *pyrosis*, according to Dr. Leared, are relieved by ten to fifteen grain doses of the black oxide—not the commercial article, but the oxide purified by washing with hydrochloric acid. In these disorders the effects of manganese are similar to those of bismuth (nitrate and carbonate), of zinc, and silver (oxide). Small doses of manganese (sulphate) may be usefully combined with iron and quinine when prescribed *to promote constructive metamorphosis*. ℞ Quininæ sulph., ferri sulph. exsic., mangani sulph. exsic., āā ℈ j. M. Ft. pil. no. xx. Sig.: One to three pills three times a day. In *jaundice* of malarial origin, or from *catarrh* of the *biliary passages*, the author has seen excellent results from the use of manganese. ℞ Cinchonidinæ salicylat., ʒ ij; mangani sulph. exsic., ℈ ij. M. Ft. pil. no. xx. Sig.: Two pills three times a day. ℞ Fel. bovin. purif., ʒ j; mangani sulph. exsic., ℈ ij; resinæ podophylli, gr. v. M. Ft. pil. no. xx. Sig.: One three times a day in catarrhal jaundice. In the *disordered digestion of gouty subjects*, and to restore the activity of the assimilative functions after attacks of gout, manganese is most serviceable, especially as combined with salicylates.

Manganese (chloride) has been used by Osborne with success in *hæmorrhage* (*epistaxis*), and the sulphate is one of the remedies for *chronic rheumatism*, *neuralgia*, *cholera*, and *syphilis*.

An ointment of the oxide (ʒ ij — ℥ j adeps suil.) has been used with advantage in *tinea*, *scabies*, and other *chronic skin-diseases*. ℞ Mangani oxid., sulphuris, saponis dur., āā ℥ j; adipis suilli, ℥ iij. M. Ointment for *porrigo*.

Actions and Uses of the Permanganate of Potassa.—This salt is a very powerful oxidizing agent, and yields up its oxygen readily in the form of ozone. Its use as an internal and external remedy is based on this chemical fact. That it parts with its oxygen so readily is held by some to demonstrate its entire inutility when administered by the stomach. Although it must instantly be decomposed on reaching the stomach, there are satisfactory reasons for believing that it exerts a favorable influence on certain diseases in which, theoretically considered, it may be indicated. The author has seen marked advantage from its use in the *dyspepsia* and *flatulence* so constantly attendant on obesity. It has also appeared to be very serviceable as a remedy for *an abnormal* and *excessive deposition of fat.* In the so-called *uric-acid diathesis* it favors the conversion of uric acid into urea, and thus prevents the formation of uric-acid calculi. Pain in the lumbar region, frequent micturition, acid urine, much brick-dust sediment, and intestinal indigestion, are associated symptoms relieved by the permanganate. Under the same conditions, it is probable *acute rheumatism* is developed, and to the action of the permanganate as an oxidizing agent is attributable the benefit which is sometimes obtained from its use in this disease. In *scarlatina* and *diphtheria* the permanganate is used with undoubted benefit, applied to the throat and taken by the stomach. In *erysipelas, puerperal fever, septicæmia,* it has been given with advantage. Lately it has been used with success as a remedy for the *bites of venomous snakes* and other *animal poisons*, applied locally and given internally (Lacerda).

Recent trials have shown that this agent is effective against other forms of poisoning as well as that of the snake. It has been used with success in morphine poisoning, even when the poison has been absorbed and is acting on the system at large. As experiment has proved that it forms chemical combinations with alkaloids and renders them inactive, this property explains its utility when the poison is directly accessible. In cases of opium, coca, or other narcotic poisoning, when the toxic agent is yet retained in the stomach, its local action can be relied on to destroy or inhibit the poison and thus prevent systemic action. The stomach-pump having been used, the cavity should be well washed out with the permanganate solution—one or two grains to the ounce of water. Besides this local action, the evidence is conclusive that it possesses antidotal power against the systemic effects. Injected subcutaneously, it is asserted that it completely antagonizes the morphine, one grain being effective against the same amount of the narcotic. It acts in a similar manner against cocaine, and, we may well suppose, against atropine and strychnine, and other organic alkaloids. It is difficult to conceive of such remote and systemic effects, when the remarkable facility with which it parts with its oxygen in the presence of organic matter is remembered. It is known, however, that injected in the neighborhood poisoned by snake-bite, the action of the poison is arrested.

Drs. Ringer and Murrell have found it an effective remedy in the treatment of *amenorrhœa,* one or two grains being given in pill form three times a day. Since the publication of this discovery, many cases confirming its truth have been reported from all quarters. Recently it has been affirmed that the salts of manganese possess this property in common, and that it is not a special endowment of permanganate. The author can not but regard this as doubtful, since he has not obtained the same results from the other manganese preparations, although recognizing the desirability of having less irritating agents for the purpose. The dose of three to five grains recommended by Drs. Ringer and Murrell can be taken by few patients—if any—without experiencing very considerable gastric disturbance.

The mode of administering permanganate in the condition of amenorrhœa has much importance, since it is usually necessary to give the largest doses that can be taken without causing so much gastric disturbance as to compel its suspension. The best form in which to prescribe it is probably the compressed pellets containing one or two grains of the salt. A large draught of water that has been recently distilled, or, better, that has been boiled and filtered, should immediately follow the pellet—for free dilution in the stomach will not only promote absorption, but will lessen the action on the mucous membrane. The rapidity with which the color of a permanganate solution will be discharged in common river-water has been much exaggerated; the author ascertained that, when added to a vessel of the Schuylkill water, no appreciable change took place in a half-hour. Further, when a solution made by dissolving a compressed pellet in ordinary river-water is put into urine, the color is not at once discharged, but an interval of several minutes elapses before the change is completed.

That the large proportion of active oxygen present in the permanganate contributes to the therapeutical action can hardly be denied, and that it is an element in the action on the organs of menstruation must be admitted also. The author, therefore, advises the use of permanganate of potassium in amenorrhœa, rather than the salts of manganese, although the latter may be used when the former can not be borne. The remedy should be administered during the week preceding the time of the menstrual flow, and the dose given must be small, with the necessary frequency, so that about ten grains be received each day. When the other salts of manganese are substituted, such combinations as the following will be found useful: ℞ Ferri sulph. exsic., mangani sulph. exsic., āā ℈j; ext. aloes, gr. iv; ext. ignatiæ *vel* nucis vomicæ, gr. v. M. Ft. pil. no. xx. Sig.: One pill three times a day. The amount of manganese in this prescription can be trebled if need be. ℞ Ferri et mangani carb. sacch., ʒij. Ft. pulv. xx. Sig.: One powder three times a day. This latter remedy is especially commended because of its remedial value and of the ease with which it is administered, since it is almost tasteless.

The value of permanganate of potassium in amenorrhœa having been confirmed by Lvaff (Russia), Vargunin was induced to try it in cases of *dysmenorrhœa* characterized by scanty flow, and a general condition of anæmia. The result justified the *a priori* judgment, and equally fortunate cases have been reported by others since. It is a necessary condition for the successful use of permanganate in these affections that the state of the patient be that of depression, anæmia, or chlorosis, and that the organs concerned in the menstrual function be wanting in activity. Congestion or inflammation of the pelvic organs is a positive contraindication.

It should not be forgotten that pills containing permanganate of potassium in some combinations are explosive. There is, however, no actual necessity for combinations of this kind.

Among the important uses of permanganate of potassa are its external applications as a *disinfectant.* It is a *deodorizer* as well as a disinfectant. It is very frequently used (ʒ j—Oj) to correct the fetor of *cancer, ulcers, caries, abscesses,* etc. It is used as an injection, or in the form of spray, to destroy the odor of the discharges and to alter the morbid action, in cases of *ozæna, otorrhœa,* etc. It is an elegant toilet preparation (gr. j — ℥ j) for destroying the *odor of a foul breath,* the *smell of the axilla,* and the *fetor of the sweat of the feet.* See "Antiseptics" for further information.

Recently solutions of permanganate of potassium have been employed successfully in the treatment of dysentery. Among the cases thus benefited have been the formidable cases of dysentery coming from South Africa. Dr. Bennett ("Lancet," December 21, 1901) reports the cure of many cases of "asylum dysentery" in this way. For this purpose a "weak solution" is made use of to irrigate the bowel morning and evening, and this, it is reported, had "seldom to be used after the second day." This method is applicable also to any case of diarrhœa accompanied by straining.

CHALYBEATE MINERAL SPRINGS.

1. North American.

Bailey Springs, Lauderdale County, Alabama.

These springs contain carbonates of potassa, soda, magnesia, carbonic-acid gas, oxide of iron, etc.

Rawley Springs, Rockingham County, Virginia.

Carbonate of iron (0·203 grain) is the most important ingredient in these waters. They contain, also, carbonates of manganese, magnesia, lime, and lithia, and sulphates, etc.

Sweet Chalybeate Springs, Alleghany County, Virginia.

The name of this water is derived from its sweetish taste. It is highly charged with carbonic-acid gas, and contains sesquioxide of iron, with sulphate of lime (4·110 grains), sulphates of magnesia and soda, and chlorides of lime, sodium, magnesium, etc.

Rockbridge Alum Springs, Rockbridge County, Virginia.

Bath Alum, Bath County, Virginia.

These waters are remarkable for containing free sulphuric acid. They contain also sulphates of magnesia and lime, protoxide of iron, and carbonic-acid gas. The Bath Alum waters contain twice as much iron as the Rockbridge Alum.

Bedford Alum Springs, Bedford County, Virginia.

Similar in composition to the above, but contain a larger proportion of iron, and of the salts of potassa, magnesia, and lime.

Bedford Springs, Bedford County, Pennsylvania.

This water contains carbonate of iron (0·625 grain) associated with a large proportion of sulphate of magnesia (10 grains), and is, therefore, a laxative chalybeate.

2. EUROPEAN.

Bascombe, Bournemouth, Hampshire, England.

Chalybeate springs containing carbonic acid in combination.

Dorton, Buckinghamshire, England.

Contains sulphate of iron and is charged with carbonic acid. Requires dilution for drinking.

Hastings, Sussex, England.

Contains sulphates of iron, magnesia, lime, and soda.

Sandrock, Isle of Wight.

Is a strong aluminous chalybeate—41½ grains of sulphate of iron, and 31½ grains of sulphate of alumina in twenty ounces—and therefore requires dilution for drinking.

Tunbridge, Kent, England. Altitude, 289′; temperature, 50° Fahr.

This water contains one eighth of a grain of iron with carbonic acid, in twenty ounces.

Spa, Belgium. Altitude, 1,030′. Season, August and September. Temperature of water, 52° Fahr.

These waters contain carbonates of iron, manganese, soda, lime, and magnesia, etc., and are highly charged with carbonic acid.

Pyrmont, Waldeck. Altitude, 404′; mean annual temperature, 48·5° Fahr.

The quantity of carbonic-acid gas is unusually great in these waters. They contain sulphates of lime, soda, magnesia, and carbonates of iron, soda, magnesia, and lime.

Alexisbad, near Harzgerode, Germany.

Alexisbrunnen. Same.

Both contain iron and manganese in large quantity, and also carbonic-acid gas. The first named, being highly impregnated with chloride and sulphate of iron, is used for bathing, and the other for drinking.

Schwalbach, Nassau. Altitude, 909′. Season, June to September. Temperature, 64° Fahr.

According to the analysis of Fresenius, this valuable water contains bicarbonates of iron, manganese, soda, magnesia, and lime, sulphates of soda and potash, and chloride of sodium. It is very highly charged with carbonic acid.

St. Moritz, Upper Engadin, Switzerland. Altitude, 5,464′. Mean temperature of summer months, 51° Fahr.

These springs contain from ten to fourteen grains of solids in a pint, consisting of carbonates of lime, magnesia, manganese, iron, and soda, etc., and as much as 39·5 cubic inches of carbonic acid.

Therapy of Chalybeate Waters.—The uses of these waters are the same as the purely medicinal preparations of iron. They are indicated in *chlorosis* and *anæmia*, to supply to the blood the material in which it is deficient. For this purpose the milder waters, containing carbonate of iron and abundant carbonic acid, are most suitable; for example, in this country, Bedford (Pennsylvania)—Columbian Spring, Saratoga, and the "Sweet," of Virginia, etc.; in England, Bascombe and Tunbridge; on the Continent, Pyrmont, Spa, Schwalbach, St. Moritz. When *passive hæmorrhages*—the *hæmorrhagic diathesis*—require ferruginous waters, the alum and iron waters are more effective. *Amenorrhœa*, *hysteria*, and other *pelvic disorders*, when dependent on anæmia, the *paludal cachexia*, *leucocythemic-exophthalmic goitre*, are either cured or decidedly ameliorated by chalybeate waters.

The purgative iron waters are useful in *engorgement of the liver*, *hæmorrhoids*, and *dyspepsia of anæmic subjects*, in *albuminuria* and *dropsy*; the alum springs in *chronic diarrhœa* and *strumous diseases*.

Neuralgia, *chorea*, *cerebral anæmia*, and other *nervous disorders due to an impoverished condition of the blood*, are much improved by the use of the milder chalybeate waters.

In making selection of a chalybeate water the psychical influences of mountain scenery, or other pleasant surroundings, should not be disregarded. For the anæmic pulmonary invalid, elevation of the spring and the absence of humidity are important considerations to determine a selection. Hence, the present popularity of St. Moritz. In this country a great variety is afforded—mountain scenery like Bedford, Pennsylvânia, and the Virginia springs, or rolling upland like Bailey's and Sharon. As respects composition, the ferruginous springs of the United States are equal to any in the world.

For authorities referred to, *see articles on Alkaline and Saline Springs*.

The remedies promoting constructive metamorphosis previously considered are constituent elements of the human body. Those now to be discussed act indirectly, by stimulating the organs concerned in blood-making.

BISMUTHUM.

Bismuth. — *Bismuthi Subcarbonas.* —Bismuth subcarbonate. A white or yellowish-white powder, without taste or smell, insoluble in water. Dose, gr. x— ʒ j, in powder or emulsion.

Bismuthi Subnitras.—Bismuth subnitrate. A heavy, white powder, with a faintly acid odor and taste, insoluble in water. Dose, gr. x — ʒ j, in powder or emulsion.

Bismuthi Citras.—Bismuth citrate. "A white, amorphous powder, odorless and tasteless, insoluble in water or alcohol." Dose, gr. v—℈j.

Bismuthi et Ammonii Citras.—Bismuth and ammonium citrate. Small, translucent scales, soluble in water. Dose, gr. v—gr. xv.

Xeroform contains besides bismuth 50 per cent of tribromphenol, and is antiseptic and astringent. It is a greenish-yellow powder, having but little odor or taste, and is insoluble. Applied to sloughing wounds and ulcers, it is an efficient deodorant and antiseptic. Internally it acts as an astringent, corrects intestinal decomposition, and arrests diarrhœa. The dose for adults ranges from five to twenty grains, and for children two to eight grains. It is best given in wafer or capsule.

Physiological Actions.—The insoluble preparations have a very slightly metallic taste. They coat the tongue black by the formation of a sulphide. Given in suitable cases, they promote the appetite and increase the digestive power, and a gain in body-weight is one result of their administration. They are somewhat astringent, and retard the intestinal movements. As they are nearly insoluble, they pass down the intestinal tract and are converted into sulphides; hence the fæces under their use become a dark slate color. They are not entirely insoluble, for bismuth can be detected in the blood, urine, and other secretions, after a course of these medicines. Sufficient is absorbed under some circumstances, it is said, especially after prolonged administration, to cause toxic symptoms; but such a result must be due to accidental combinations, or to the presence of arsenic, which is a very constant impurity in the ordinary commercial preparations of subnitrate and subcarbonate of bismuth. Trousseau and Pidoux remark, with regard to its presumed toxic effect, as follows: "When the subnitrate of bismuth has been prepared from the perfectly pure metal, precipitated and well washed, it may be given in single doses from one to four grammes (fifteen grains to a drachm) without producing the least *malaise*." According to the same authority, Dr. Monneret has often given as much as ten to sixty grammes a day, without any recognized ill effects. It may therefore be concluded that the action of bismuth is chiefly local. The elaborate investigation of Steinfeld, made on animals, does not affect the question as just stated. His results were obtained by injecting solutions into the blood, and thus new elements enter into the problem, not of a character to be considered as pertaining to the stomachal administration of insoluble salts.

Therapy.—In the *aphthæ* of children, *nursing sore mouth*, the milder cases of *mercurial salivation*, and in those painful ulcers of the mucous membrane of the mouth due to disorders of digestion, bismuth applied freely to the affected parts is often very serviceable, by diminishing the pain and promoting the healing process. Bismuth allays the irritability of the mucous membrane in cases of *acute indigestion*, if given after the contents of the stomach are fully evacuated. It is especially indicated when there is not only *painful digestion*, but a *tendency to diarrhœa*, the inclination for stool coming on soon after the food has been taken. It is given with great advantage in *subacute and chronic gastritis*, and in *gastralgia* arising from a state of irritation of the gastric mucous membrane. It is contraindicated, and is not beneficial, in the gastralgia produced by habitual constipation and in the gastralgia of chlorosis and hypochondria. The pain and vomiting attendant on *gastric ulcer* and *scirrhus of the stomach* are relieved by bismuth, and in the case of the former disease this remedy contributes to the cure. In these painful affections, the good effects of the bismuth are enhanced by combination with morphine. ℞ Bismuthi subnitrat., ʒ ij ; morphinæ sulphat., gr. j. M. Ft. pulv. no. vj. Sig.: One three times a day in milk. When morphine is, from any cause, inadmissible, hydrocyanic acid may be given in a mixture with bismuth. ℞ Bismuthi subnitrat., ʒ ij ; acid. hydrocyan. dil., ʒ ss ; mucilag. acaciæ, aquæ menthæ pip., āā ℥ ij. M. Sig.: A tablespoonful three times a day. Although arsenic as an impurity is so objectionable that special pains are taken in the pharmaceutical process to separate it in the preparation of subnitrate, yet the author has witnessed excellent results from a combination of arsenic and bismuth in the more chronic stomach-disorders for which the latter is prescribed.

When bismuth is not well borne by the stomach, it may be combined with aromatic powder, or, when alkalies are indicated, it may be given with chalk or magnesia. When constipation is produced by it, bismuth can be administered with rhubarb or magnesia.

Bismuth is one of the remedies most frequently employed in the treatment of the *vomiting of teething children, cholera infantum, and summer diarrhœa.* Numerous combinations are employed: with pepsin, when these disorders appear to depend on the condition known as *apepsia*, the discharges containing masses of undigested casein; with rhubarb, when the symptoms are produced by undigested aliment, or when the stools are white and pasty; with soda and chalk, when the stools are acid and excoriate the buttocks. In cases of *vomiting of pregnancy*, the *vomiting of teething children*, *acidity*, and *pyrosis*, excellent results are sometimes obtained from bismuth and carbolic acid. ℞ Bismuthi subnitrat., ʒ ii ; acid. carbol., gr. ij—gr. iv ; mucil. acaciæ, ℥ j ; aquæ menthæ pip., ℥ iij. M. Sig.: A tablespoonful for adults and a proportionate quantity for children three or four times a day.

The *diarrhœa of typhoid fever* is restrained by bismuth in scruple to half-drachm doses. In *chronic diarrhœa* large doses of bismuth are beneficial and often curative, but thirty to sixty grains must be given every three or four hours. Equally large doses check the *diar-*

rhœa of phthisis. The salicylate of bismuth has been much used of late in these maladies, and its action, especially in typhoid, has been much commended.

Bismuth is employed for a variety of purposes in the treatment of *external maladies.* It is a good application to the reddened surface of the skin in cases of *acne rosacea,* and may be used as a cosmetic in this mortifying disease. The author has seen excellent results from the free application of bismuth in cases of *eczema* when there was much serous exudation. Under the crusts thus formed healing proceeded satisfactorily. In *intertrigo* and in the *erythema* which occurs about the genitals of infants, dusting the affected surface with bismuth soothes the pain and promotes healing. Bismuth is one of the numerous applications to the eye in cases of *chronic conjunctivitis* and *granular lids.* It is also used as an injection, mixed with mucilage, or with cocoa-butter in the form of a suppository, in *chronic gonorrhœa* and in *gleet,* and in *leucorrhœa.* ℞ Bismuthi subnitrat., gr. vj ; hydrarg. chlor. cor., gr. ss ; tinct. camphoræ, ♏ jss ; aquæ ad ℥j. M. Lotion for skin diseases.

The best vehicle for the administration of bismuth is milk. It should be given before meals as a rule when employed in stomach-disorders.

Bismuth (subnitrate and salicylate) has become a very popular antiseptic dressing for *wounds, ulcers,* and *epithelioma.* Eltzina succeeded in curing an unpromising case of noma by the application of bismuth and resorcin. Gosselin and Herét have employed it as an antiseptic dressing for wounds in general, and they advocate it for its influence over the process of suppuration, and its power to prevent septic decomposition. On the other hand, Dr. Delbastaille finds various objections to the use of bismuth for surgical dressing, although admitting its antiseptic power. The weight of evidence is in its favor, on the whole.

Dermatol is the proprietary designation of the subgallate of bismuth. It contains somewhat more than 50 per cent of the oxide of bismuth. It is a yellowish, odorless, and permanent powder, insoluble in the ordinary menstrua. For internal administration it may be prescribed in powder, wafer, or capsule, in tablets or pills, or suspended in mucilage. The dose ranges from 5 gr. to ℈j. In surgical practice it may be applied in powder or in the form of gauze.

ACTIONS AND USES.—Topically, it is astringent, deodorant, and antiseptic. Opinions differ somewhat as to its germicide power. Wiemer, for example, highly extols it for its antiseptic qualities ; Stone, of Boston, holds that it is not destructive of pathogenic organisms, basing his opinion on culture experiments. There is, however, a general consensus of opinion as to its power to prevent septic decomposition, to change the character of poisoned wounds, to prevent or arrest suppuration. According to Hecht, of Breslau, it is an efficient hæmostatic, quickly arresting hæmorrhage from accessible parts.

As a local application, it is much esteemed by ophthalmic and aural surgeons in suppurating wounds and ulcerations. In surgical practice in general it has been found a valuable antiseptic dressing in the treatment of unhealthy wounds, abscesses, sinuses, and to promote healing without suppuration in the case of ordinary wounds. It is said to be an excellent application in the intertrigo of children, in eczema, and in general in cases with abundant secretion. It affords great relief in excessive and fœtid perspiration of the feet. Suspended in mucilage, dermatol is a capital injection in gonorrhœa, and as a dry powder is an excellent application to soft chancre and to herpes of the prepuce.

By Colasanti and Dutto, dermatol is held to be the great antidiarrhœa medicine. They havė found it highly effective in the enterocolitis of children, in the diarrhœa of phthisis and of typhoid fever. It has proved useful in the author's knowledge in chronic diarrhœa. In gastric catarrh, pyrosis, acid fermentation, and in general when there is excessive secretion in stomachal disorders, it has proved highly useful. When pain is present in these maladies, opium can be combined with it.

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ARSENICUM.

Arsenic.—*Acidum arsenosum ; arsenous acid. Acide arsénieux*, Fr. ; *Arsenige Säure*, Ger. Dose, $\frac{1}{30}$—$\frac{1}{10}$ grain.

Arseni Iodidum.—Arsenic iodide. Is an orange-red, crystalline solid, soluble in 7 parts of water, and wholly volatilized by heat. Dose, gr. $\frac{1}{20}$.

Liquor Acidi Arsenosi.—Solution of arsenous acid. Dose, ♏ ij—v.

Liquor Arseni et Hydrargyri Iodidi.—Solution of arsenic and mercury iodide ; Donovan's solution. Dose, ♏ ij—v.

Liquor Potassii Arsenitis.—Solution of potassium arsenite. Fowler's solution. (Arsenous acid, potassic bicarbonate, compound spirit of lavender, and distilled water.) Dose, ♏ ij—x.

Liquor Sodii Arsenatis.—Solution of sodium arsenate ; Pearson's solution. Dose, ♏ ij—xx.

The organic compound of arsenic called cacodylic acid has recently come into use. It is much less poisonous, and its combination with sodium is freely soluble in water and can be given subcutaneously.

It is used successfully in the treatment of pernicious anæmia and in incipient phthisis. The dose of this salt is from one grain.

When a course of arsenic is begun, large doses should be prescribed, and the quantity administered should be regularly reduced. In this way chronic arsenical poisoning is avoided. When continually increasing doses are given, the arsenic accumulates, and toxic symptoms are quickly induced. As a rule, unless very small doses are prescribed, arsenic should be taken after meals. Some subjects are soon seriously affected by even small doses of arsenic. For this reason, when the idiosyncrasies of the patient are unknown, it were better to make tentative experiments with a few small doses before beginning with large ones. A few drops of laudanum given with arsenic will enable it to be better borne by some susceptible subjects.

ANTAGONISTS AND INCOMPATIBLES.—The salts of iron, magnesia, and lime, and astringents, are chemically incompatible. The arseniate of iron, although not actively so, does cause toxic symptoms if continued in full medicinal doses. The hydrated sesquioxide of iron, *freshly precipitated*, and in a soft magma, is the antidote to *arsenic in solution*. About eight grains of the antidote are required for each grain of the poison swallowed. As the hydrated sesquioxide of iron is harmless, it should be given in teaspoonful to tablespoonful doses, every few minutes. In every case of poisoning by arsenic, prompt efforts to secure evacuation of the contents of the stomach are necessary. Large doses of the antidote may be given with the emetic employed. In the absence of the hydrated sesquioxide of iron, magnesia, chalk, and lime-water may be given freely. These agents act in part, and probably chiefly, mechanically, by enveloping the particles of arsenic, and so hindering absorption. It is held by some that freshly precipitated hydrate of magnesia is more effective as an antidote than the hydrated sesquioxide of iron. Large draughts of oil, milk, and substances containing mucilage, by protecting the mucous membrane, render important service in cases of arsenical poisoning. Dialyzed iron, later experiences show, is quite as efficient as the hydrated sesquioxide, and is always ready. It is an important point to favor rapid elimination of the poison when the patient survives the acute symptoms. This is accomplished by the use of diluent drinks, skimmed milk, slightly alkaline mineral waters, etc.

SYNERGISTS.—All those agents which promote constructive metamorphosis are synergistic to arsenic.

PHYSIOLOGICAL ACTIONS.—Applied to the tissues, arsenic excites violent inflammation and causes destruction of the part; it is, therefore, an escharotic. Great pain attends its action. In consequence of the high degree of inflammation which it excites, when applied in sufficient strength, absorption does not follow its local use, but weak applications may excite dangerous symptoms by diffusion into the blood.

Symptoms of poisoning follow the inhalation of arsenical fumes. Numerous instances have occurred in which wall-papers colored with arsenical pigments have poisoned the occupants of an apartment. Garments covered with aniline dyes, fixed by arsenical mordants, have induced local ulcerations and systemic symptoms from absorption of arsenic. Applications to a large portion of even the unbroken integument, and to ulcerated surfaces, have, in numerous instances, excited dangerous symptoms, and have produced fatal results. That arsenic, wherever applied, manifests a selective action on the mucous membrane of the respiratory and digestive tracts, is a curious fact.

Arsenic, in small medicinal doses, promotes the appetite and digestive functions, and improves the body nutrition. It increases secretion of the gastro-intestinal mucous membrane, and hastens the peristaltic movements. Arsenic diffuses into the blood with facility. It probably enters into combination with the red blood-globules. It certainly lessens the excretion of carbonic acid, probably also of urea ; in other words, it checks the retrograde metamorphosis. It stimulates the cerebral functions and induces a feeling of well-being, and in some subjects decided mental exhilaration.

In larger doses, yet not in quantity to produce acute poisoning, and when full medicinal doses have been administered for a lengthened period, arsenic causes more characteristic physiological actions than are described above. As regards the digestive organs, the following phenomena occur : A metallic taste ; increased flow of saliva ; nausea, vomiting of glairy mucus, epigastric pain, and soreness ; diarrhœa, tenesmus, and sometimes dysenteric stools. As regards the circulatory and respiratory organs : the action of the heart becomes irritable and feeble, palpitations, cough, oppressed breathing, œdema of the eyelids, general œdema, and albuminuria occur. As regards the skin : itching of the eyelids, urticaria, eczema, pityriasis, psoriasis, and falling out of the nails and hair. As regards the nervous system : disorders of motility—trembling, stiffness, and contraction of the joints, disorders of sensibility, herpes zoster.

Notwithstanding the effects above described are so frequently observed to follow the use of arsenic, it is undoubtedly true that a certain degree of *tolerance* may be established when doses in themselves toxic can be taken with impunity. This state has been produced in a course of the legitimate administration of arsenic, and has been witnessed on a considerable scale among the arsenic-eaters of Styria and Southern Austria. The arsenicophagi begin the habit of arsenic-eating at an early age, and become habituated to the use of enormous doses. They find that this practice is serviceable in several respects : they improve in bodily condition, gain in breathing-power, and become stronger and more pugnacious, and also more salacious.

When arsenic is swallowed in sufficient quantity to cause the symptoms of acute poisoning, the phenomena produced are of two kinds—gastro-intestinal irritation and cerebral effects. The former is much the more common. The following are the symptoms of the gastro-intestinal form of acute arsenical poisoning: Burning at the epigastrium and radiating thence over the abdomen; violent and uncontrollable vomiting; great dryness of the mouth and fauces; intense thirst; intestinal irritation, bloody and offensive stools, retracted abdomen; strangury, priapism, suppression of urine or bloody urine, and in females menorrhagia; rapid and feeble action of the heart, oppressed breathing; great agitation and restlessness; shrunken features, cold breath; involuntary evacuations; collapse — consciousness being retained to the last. In the cerebral form of acute poisoning, without any symptoms of gastro-intestinal irritation, the patient is suddenly put into a condition of profound insensibility and coma, not unlike extreme opium narcosis.

Recovery from the effects of acute arsenical poisoning is rarely complete. For a long time afterward a considerable degree of gastro-enteric irritability will persist, and life may at last be lost from the continued operation of this pathological state on the function of nutrition. An irritable state of the skin and stiffness of the joints may also continue for some time, and paralysis may supervene, accompanied with neuralgic pains, numbness, formication, etc.

The changes found after death in the gastro-intestinal mucous membrane are those due to an irritant: deep redness, erosions, ecchymoses, and softening. These alterations are also produced when toxic effects are caused by the external application of arsenic. More or less redness of the tracheal and bronchial mucous membrane and congestion of the lungs have been observed. It must not be forgotten that arsenic has caused a fatal result without producing any gastro-intestinal lesions except some uncharacteristic redness. Fatty degeneration of the liver, kidneys, spleen, and other organs, has been observed in cases of acute poisoning, even when the symptoms have existed for a few hours. The icterode hue of the skin and the albuminuria which occur in the course of chronic arsenical poisoning are probably due to fatty degeneration of the liver-cells and of the renal epithelium.

Arsenic, although like other mineral poisons it tends to accumulate in the system, is nevertheless eliminated with considerable rapidity. If the patient survive a week after the ingestion of a toxic dose, it is difficult to detect it in the body after death. If the poison is retained and death ensues before elimination can take place, it undoubtedly retards putrefaction. Arsenic is eliminated by various organs—by the liver, intestinal canal, kidneys, and bronchial tubes—and some of the symptoms produced by it probably have their origin in the local effect of the poison on the channels of excretion.

The quantity of arsenic required to produce a fatal effect varies according to the state of the stomach and the susceptibilities of the patient. Ounces have been swallowed without producing even serious symptoms, because promptly rejected by vomiting. When the stomach is full of food, absorption is slow and vomiting is easily induced, and hence a toxic dose may not under these circumstances produce any of the phenomena of poisoning. A half-grain of arsenious acid has caused symptoms of poisoning (Taylor), and, according to the same authority, from two to four grains may prove fatal to an adult. Much depends on the idiosyncrasies of the individual, which, as has been stated above, differ greatly in different persons. These facts should not be forgotten in prescribing strictly medicinal doses of arsenical preparations.

From this general survey of the effects of arsenic, we may properly proceed to study the results of more minute investigations. Virchow has pointed out the similarity in the *post-mortem* appearances of arsenic and of cholera. The cholera-fungus of Klebs and the characteristic rice-water contents of the intestinal canal were not wanting to complete the resemblance. Hoffman has since fully confirmed these observations. Croupous exudations are sometimes encountered in the stomach and intestines, and crystals of arsenic have been found imbedded in the false membrane. This result is due to the action of arsenic when swallowed in powder, and is not produced when the poison is taken in solution (Filehne, Lesser). The gastro-intestinal inflammation, present in a large proportion of cases, is due in part to the local action of the arsenic, in part to its selective action, but this fact does not justify the statements of Böhm and Unterberger that a larger dose of the poison is required to destroy life by the intravenous injection than by the stomachal administration. Lesser holds with the authorities in general that arsenic, in common with other poisons, is more fatal by intravenous injection. In a small proportion of cases, as has been stated, gastro-intestinal inflammation does not occur, but the effects of the poison are expended on the nervous centers ; several hours after the ingestion of a large dose, delirium, followed by coma, and convulsions come on, and with these albuminuria, occasionally urinary suppression. The relation of the attacks of eclampsia to the albuminuria has not been settled. In still other cases the gastro-intestinal disturbance, the rice-water discharges, the collapse, simulate the algid stage of cholera. The remarkable fall in the blood-pressure of the abdominal vessels produced by arsenic certainly throws light on these phenomena (Böhm and Unterberger).

The experiments of Sklarek have demonstrated that arsenic decidedly impairs sensibility, leaving the motor functions untouched. In the human subject, however, as the result of acute poisoning, and sometimes after the acute symptoms have subsided, certain paralyses develop. They may be preceded by numbness and tingling, and may be accompanied by contractures which disappear in curable cases, and remain permanently in incurable cases. The paralysis may be limited to a single member, and when several are thus affected the usual form of paralysis is paraplegia ; but all four members may be thus disabled. The rectum and bladder are not affected (Christison). These clinical observations by Christison are confirmed by the researches of Ringer and Murrell, who have shown that Sklarek's statements were incorrect, and that motor paralysis precedes sensory paralysis in the frog poisoned by arsenic. (*See* Ponteland Poisoning Cases, "Lancet," September, 1866.)

The effects of arsenic on the circulation are not the same in cold and warm blooded animals, for, according to Sklarek, in the former the action of the heart is slowed, then arrested, while in the latter the action of the heart persists after the cessation of respiration (Böhm and Unterberger, Lesser). This fundamental difference in the action of arsenic on the two classes of animals requires us to accept with caution the observations made on the vaso-motor system of the cold-blooded. It has been pretty definitely ascertained that arsenic causes a fall in the blood-pressure, which is especially strong in the abdominal blood-vessels (Böhm and Unterberger).

A fact of great importance, first ascertained by Saikowsky, is the fatty degeneration of the liver, kidneys, heart, and other organs. The case of Grohl and Mosler, reported in the same volume of Virchow's "Archiv" containing Saikowsky's paper, is confirmatory more or less completely of the observations in the latter. They found, as their figures well exhibit, fatty degeneration to a greater or less extent in the glandular epithelium of the intestinal canal, and less conspicuous evidences of the same change in the kidneys, the liver, and the muscular tissue of the heart. As the extent of the change is determined largely by the duration of the case, when death occurs in a few hours, or in a day or two, little alteration is discernible.

The effect of arsenic on the function of nutrition is as yet involved in doubt. It is a recognized fact that arsenic promotes constructive metamorphosis when administered in medicinal doses. It has been ascertained by Saikowsky that it arrests the formation of glycogen by the liver, and C. Schmidt has shown that it lessens the excretion of carbonic acid and urea. Although doubt has been thrown on these statements, they seem to be supported by the observations of Lesser on the temperature, which has been constantly and considerably depressed under the action of lethal doses. The effect of arsenic in lowering the functional activity of the respiratory center is a fact which supports the same view, for a diminution in the quantity of oxygen admitted to the blood must necessarily lessen the rate of oxidation. On the other hand are the adverse experiments of Kassel, a medical student under Prof. Gäthgens, and Gäthgens himself, which apparently demonstrate an actual increase in the amount of urea excreted. Arsenic has an anti-fermentative action; but it is not universally destructive of the minute organisms on the presence of which the various fermentations are dependent. Thus it is poisonous to *Torula cerevisiæ* and to some micrococci, but not to all, and it does not impair the activity of certain animal ferments, as pepsin, pancreatin, etc. (Johannsohn, Schäfer, and Böhm). On the trophic system it acts as a depressant when taken in considerable quantity. The dust from arsenical wall-papers has induced a cachectic state, accompanied by headache, vertigo, and tinnitus (Donkin). Aniline dyes fixed by a mordant of arsenic have excited ulceration of the nails, phlegmon of the hands, and anæsthesia and paresis of the extremities (Clemans).

Therapy.—The preparations of arsenic are applicable to the treatment of the diseases of those tissues upon which it has a selective action.

No remedy is more useful than arsenic in the so-called *irritative dyspepsia*, manifested by these symptoms: a red and pointed tongue, poor appetite, distress after meals, the presence of the food causing intestinal pain, colic, and the desire to go to stool. Drop-doses of Fowler's solution, given before meals, quickly relieve this state of things. The effects of the arsenic are frequently favored by the conjoint administration of a little laudanum.

In some cases of the *vomiting of pregnancy*, a drop of Fowler's solution given before each meal will afford astonishing relief. The particular indications for its use are these: vomiting of food, followed by retching and straining, the vomited matters being streaked with blood, or blood alone being thrown up; these symptoms accompanied by gastralgia and pain between the scapulæ.

The vomiting of *chronic gastric catarrh*, especially the alcoholic form, is relieved by one or two drops of Fowler's solution taken before meals. It effects a cure in these cases by relieving the morbid state of the mucous membrane on which the vomiting depends. Arsenic is also very beneficial in these small doses in *chronic ulcer of the stomach*. It checks the vomiting, relieves the pain, and improves the appetite for food. It is not equally effective in the *acute ulcer*. Although arsenic exercises but little influence over the progress of these cases, it is very serviceable in *cancer of the stomach*, by diminishing the pain and checking the vomiting. *Gastralgia* and *enteralgia*, when idiopathic, are sometimes made to disappear in a very surprising manner by the same remedy, but there are no certain indications of the kind of case to which it is best adapted.

In the treatment of stomach-disorders, only small doses of arsenic are admissible. Large doses, by creating an irritation of the gastric mucous membrane, will only defeat the end in view.

That form of *diarrhœa* which consists merely in an intolerance of the presence of food, an evacuation of the undigested aliment taking place soon after it is swallowed, is cured by arsenic. *Chronic diarrhœa* and *dysentery* (entero-colitis), especially when dependent on the changes induced by chronic malarial infection, are often greatly benefited by the same remedy. In these cases, two drops of Fowler's solution with five drops of laudanum should be given before meals. Attention to the diet is, of course, imperative. *Constipation*, when due to deficient secretion and dryness of the fæces, is sometimes overcome by small doses of Fowler's solution.

Arsenic is one of the numerous remedies proposed for the treatment of *epidemic cholera.* It is a curious circumstance, first demonstrated by Virchow, that some cases of acute arsenical poisoning are not distinguishable by their symptomatology or morbid anatomy from cases of epidemic cholera.

Arsenic has been used with success in the treatment of the *jaundice* due to catarrh of the bile-ducts succeeding to catarrh of the duodenum. It seems to the author to be better adapted to cases of *jaundice* of *malarial* origin. Excellent results are obtained by the persevering use in small doses of arsenic in *cirrhosis.* As arsenic tends to accumulate in the liver, and as it produces fatty degeneration of this organ, the curative effect in the above-named disorders may depend on this selective action.

There is no doubt that arsenic promotes in a very decided manner the constructive metamorphosis. It is one of the most valuable agents which we possess in the treatment of *chlorosis* and *anæmia.* It is especially adapted to those cases in which iron does not agree or fails of effect. The efficiency of iron in these disorders is much increased by combination with arsenic.

Cases of *acute coryza* and *hay-asthma* are often decidedly relieved by this remedy. *Chronic catarrh of the broncho-pulmonary mucous membrane, emphysema, sclerosis of the lungs,* are maladies in which arsenic, long used in ordinary medicinal doses, is capable of effecting considerable amelioration. We have no single drug of equal utility in the chronic forms of *phthisis,* but it is not serviceable in caseous pneumonia. It is said, and this statement corresponds to the author's observation, that, when there are much hectic and rapid disintegration of the pulmonary tissues, arsenic is not beneficial. Besides the stomach administration of arsenic in the above-mentioned maladies of the respiratory organs, it is used with advantage by the process of fumigation. The following is the formula of Trousseau for arsenical cigarettes:

Arsenite of potassa	15 grains.
Distilled water	1 ounce.

Unsized white paper is thoroughly moistened with this solution, dried and cut into twenty equal parts, and each part rolled into a cigarette. Two or three of these are smoked daily for the relief of *chronic bronchitis, emphysema, spasmodic asthma, phthisis, hay-asthma*, etc. The arseniate of soda may be used in the same way, and under the same conditions; for example, take a half-drachm to one drachm of arseniate of soda, one ounce of distilled water, and moisten a bit of unsized paper with the solution, so that every piece of a given size shall contain a determined quantity of the arsenic, ordinarily from one fourth to one grain. When the cigarette is lighted, the patient inhales the smoke by a single inspiration, and this inhalation is practiced three or four times a day. In cases of *acute and chronic coryza*, great advantage is obtained by snuffing into the nares the fumes of arsenical cigarettes. The arsenite of antimony, according to Dr. Lucien Papillaud, is especially serviceable in pulmonary affections.

When, in consequence of feebleness of the heart, there are present *short breathing* on making slight exertion, and *œdema of the feet and ankles*, especially as these symptoms occur in old people, arsenic is indicated. Attacks of *angina pectoris* may be lessened or prevented by the persistent use of arsenic in the interval.

Certain disorders of the nervous system are greatly benefited by the use of arsenical preparations. The author has seen it extremely useful in *cerebral congestion*, for the treatment of which it was originally recommended by Dr. Lemare-Picquot. It is indicated when there are commencing atheromæ of the cerebral vessels, sluggish venous circulation, puffiness of the eyes, tendency to drowsiness, and intellectual torpor. In the *melancholy* and *hypochondria* of the aged, it gives great comfort, and frequently entirely dispels the gloomy fancies which take possession of the mind under these circumstances. The arsenic acts most favorably when combined with minute doses of opium; viz., two drops of Fowler's solution, with three to five drops of tincture of opium, given three times a day. Arsenic is one of the remedies successful in the treatment of *neuralgia*. Generally its curative influence is indirect, and exerted through the improvement in the bodily nutrition which follows its administration. It is directly curative, however, in the cases of *hemicrania*, and other *neuralgiæ* of *malarial origin*, but it holds a place strictly secondary to quinine in these affections. It is certainly one of the most effective remedies which we possess in the treatment of *chorea*. In this disease, large doses—five minims *ter in die*—must be given. Young subjects, it should be remembered, bear large doses of arsenic, relatively, better than adults. Cases of *epilepsy* have been reported cured by arsenic, but these were probably instances of *epileptiform vertigo* caused by stomach-disorder, in which this remedy is undoubtedly of great utility. Charcot has found the subcutaneous injection of Fowler's solution of real value in *paralysis agitans*. The same expedient has succeeded in *local chorea* and *histrionic spasm*. The injection should be made into the affected muscles, whenever practicable.

Arsenic produces, in the course of its medicinal administration, affections of the skin, and notably those dependent on an unknown state of the trophic nerves. In the treatment of various skin-affections we avail ourselves of this physiological fact, and set up by means of arsenical preparations a *substitutive* action in the skin. It follows, that arsenic will not be serviceable in *acute* affections of the skin, and experience demonstrates that, whenever active cell-proliferation is taking place, arsenic is contraindicated. It is most serviceable when the affection of the skin is superficial in its seat—in the epidermis and the superficial layers of the derma. In cases of *psoriasis* much good may be expected from it, but, the more chronic the disease, the more beneficial is it. When the arsenic begins to exert an influence on *psoriasis*, the skin appears more inflamed, but this is an evidence that the curative action is taking place, and the remedy should then be persisted in. *Acute eczema* is rather exasperated by arsenic, but *chronic eczema*, especially *eczema squamosum*, is often greatly benefited by it. When eczema infests the vulva, anal region, and scrotum, arsenic is said to be useful, but its efficacy in these cases is largely determined by the chronicity of the attacks. *Pemphigus* is an affection of the skin which, as was more particularly shown by Mr. Hutchison, is curable by arsenic, but the more chronic the disease the more certainly beneficial the remedy. In old cases of *acne*, especially *acne rosacea*, arsenic is sometimes serviceable, but it is often very disappointing. The author has not observed much good to follow the use of arsenic in the acne which occurs at puberty and for some years subsequently. In all cases of acne the strictest attention to diet and a proper hygiene is very important. Arsenic given with bromide of potassium lessens or prevents the very disfiguring *acne* which appears in the course of the administration of that agent. *Furuncle* (boils) is successfully treated by the long-continued use of arsenic. This practice is strongly urged by Dr. Delioux de Savignac. A succession of boils is the indication for the use of this remedy.

In the treatment of skin-affections, Fowler's solution is the arsenical preparation most frequently employed. The commencing dose need not be larger than five drops three times a day, given after meals. It is better to commence with the maximum dose, and to diminish the amount gradually. As arsenic needs to be administered for a long time in skin-diseases, such toxic symptoms as irritation of the eyelids, puffiness of the eyes, and epigastric pain and soreness, are apt to arise. These symptoms are indications for the use of laxatives, and for a reduction in the dose of the remedy, but not for its entire suspension. In order to prevent relapses, the use of arsenic should be continued, in diminishing doses, for some time after the entire disappearance of the eruption.

Arsenic is very useful in a certain form of *chronic arthritis*. The cases to which it is adapted are those in which the joints become tumid and stiff and painful in consequence of a peculiar state of the nervous system; indeed, the condition is one allied to neuralgia, the trophic nerves being involved. This is a malady very different from that kind of chronic rheumatism or rheumatic gout which is accompanied by nodosities of the joints, in which arsenic has been recommended, but over which, according to the experience of the author, it exerts no control.

Arsenic has seemed to the author remarkably beneficial in *diabetes* of hepatic origin. It has also been found useful by Johannsohn. Arseniate of soda has lately been shown to be a very excellent remedy. It may usefully be given with phosphate of sodium—ʒ j of the phosphate and $\frac{1}{15}$ of the arseniate of soda three times a day dissolved in warm water. At the present time Clemens's solution of bromide of arsenic is much in favor as a remedy for diabetes, and I therefore subjoin the formula for preparing it: Powdered arsenious acid and carbonate of potassium, of each 57½ grains; boil in 8 ounces of distilled water until dissolved, and when cold make up to 11½ troy ounces by sufficient distilled water. To this solution add 115 grains of pure bromine. The resulting solution should be well shaken several times a day during the first week. It should be colorless at the expiration of the fourth week, when it is fit for use. The dose is one drop three times a day, gradually increased to three drops. It should be given in about two ounces of water. Brunton reports good results from its administration in *albuminuria*, apparently due to defective digestion of albumen.

Amenorrhœa, when due to functional inactivity of the ovaries, and *menorrhagia*, when produced by anæmia, are equally benefited by the preparations of arsenic, especially when combined with iron. *Spermatorrhœa*, if dependent on a weak and relaxed state of the seminal vesicles, and *functional impotence*, are sometimes greatly improved by full doses of the arseniate of iron.

Next to quinine, arsenic has the most important position in the treatment of *malarial fevers*. It may be used to prevent the recurrence of attacks of *ague* when quinine for any reason is not admissible. As regards acute malarial toxæmia, arsenic is more useful as an adjunct to quinine than as the sole remedy. The treatment of acute cases may be formulated as follows: large doses of quinine to interrupt the paroxysms, and at the septenary periods; arsenic given daily to prevent relapses. It plays a more important *rôle* in chronic malarial diseases. As has been shown by Boudin, arsenic diminishes the engorgement of the spleen. The author has witnessed the rapid disappearance of *malarial jaundice*, and the cure of the alterations in the glandular appendages of the intestinal mucous membrane, under its use. It is most useful generally to combine iron with arsenic in the chronic form of malarial disease. ℞ Mas. ferri carbon., ʒ j; acidi arseniosi, gr. j.

M. Ft. pil. no. xx. Sig.: One three times a day. ℞ Quininæ sulph., ʒj; ferri sulph. exsic., ℈j; acidi arseniosi, gr. j. M. Ft. pil. no. xx. Sig.: One three times a day. Boudin justly insists upon abundant alimentation during a course of arsenical treatment of intermittents, and, with a view of preparing the digestive organs, administers a preliminary emetic to relieve the stomach of the *embarras gastrique*. Arsenic has also been used as a *prophylactic* against malarial infection, and as a remedy for various intermittent diseases due to malarial influence. The author has seen excellent results from the use of small doses of Fowler's solution three times a day in *typho-malarial fever*. When there is much diarrhœa, a few drops of tincture of opium should be added to each dose of arsenic. In doses of half a drop to one drop of Fowler's solution, the tongue cleans, the skin becomes moist, and the delirium lessens sometimes in a most remarkable manner. When arsenic is used alone in the treatment of intermittents, large doses are necessary. Ten drops of Fowler's solution may be given after meals to adults, but in a few days—three, four, or five, according to the susceptibility of the patient—the dose must be reduced two drops each day until four drops are reached. If the stomach does not become disordered, slight irritation of the conjunctivæ and puffiness of the eyelids may be disregarded.

There can be no doubt that the long-continued use of small doses of arsenic exercises a favorable influence over the course and progress of *epithelioma*. It has appeared, indeed, to be useful in *scirrhus*, especially as this morbid process manifests itself in the stomach. *Rodent ulcer*, which is closely allied in its nature to epithelioma, is also improved by it. With the internal use of the arsenical preparations may be conjoined the local applications of arsenious acid. Many physicians, notably the late Dr. Atlee, of Philadelphia, entertain the belief that the long-continued use of arsenic retards the growth of *uterine cancer*. Billroth reports a case of *multiple lymphoma* cured by the use of arsenic.

External Uses of Arsenic.—An arsenical paste having the following composition is used to destroy the sensibility of a carious tooth: arsenious acid, ij; sulphate of morphia, j; sufficient creosote to make a paste. A small quantity of this is applied by a bit of cotton-wool to the carious portion of the tooth.

Arsenious acid is sometimes employed to destroy cancerous growths. But, as it is extremely painful, and as the danger of absorption is great, other escharotics, as, for example, the chloride of zinc, are generally preferred. When it is used, the operator should be careful to employ an arsenical paste of sufficient strength to set up a limiting inflammation, and thus prevent absorption. From one sixth to one fifth of arsenious acid is the proper proportion, and it may be mixed with calomel, starch, or other impalpable powder. If the surface to be destroyed is large, a portion of it should be submitted at a time to the action of the escharotic. Poultices should then be applied until the slough separates, when a healthy granulating surface is obtained. The excessive pain caused by the escharotic may be much alleviated by combining morphine and carbolic acid in the arsenical paste, or by the use of morphine hypodermatically until the escharotic action ceases.

An arsenical paste prepared as follows is sometimes used as a depilatory: quicklime, ℥ ss; yellow sulphide of arsenic, grs. xx; starch, ʒ ij. Sulphide of barium and oxide of zinc is a more efficient combination. Esmarch's caustic is composed of: Arsenious acid, one part; morphine sulph., one part; calomel, eight parts; and powdered acacia, forty-eight parts. Mix. Sprinkle thickly every day on a surface either raw or denuded of cuticle by a blister.

In addition to the above local uses of arsenic, the results achieved by its hypodermatic injection should be mentioned. Dr. Radcliffe was the first to employ this practice in cases of *local chorea* of the head and neck, and in *histrionic spasm*. In these affections Fowler's solution or Pearson's, in doses of two to ten minims, diluted with an equal measure of water, is thrown into the affected muscles daily, sometimes curing after some weeks of treatment. In obstinate cases of general chorea the subcutaneous injection of arsenic is now practiced, with good effects, a cure resulting more speedily than by the stomachal method of administration. Arsenic used by this method has proved to be the most effective remedy for *lymphadenoma*.

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THE SIMPLE BITTERS.

Quassia.—*Quassi amer*, Fr.; *Quassienholz*, Ger. The wood of *Picræna excelsa* Lindley (*Quassia excelsa* Swartz; Nat. Ord. *Simarubaceæ*).

Preparations.—*Extractum Quassiæ.* Extract of quassia. Dose, gr. j—gr. iij.

Tinctura Quassiæ.—Tincture of quassia (100 grm. to 1,000 c. c. of diluted alcohol). Dose, ♏ v — ʒ j.

Extractum Quassiæ Fluidum.—Fluid extract of quassia. Dose, ♏ v— ʒ ss.

Composition.—Quassia-wood contains a crystallizable bitter principle, neutral, called *quassin*.

Gentiana.—*Gentian*, *gentiane*, Fr.; *Bitterwurzel*, Ger. The root of *Gentiana lutea* Linné (Nat. Ord. *Gentianaceæ*).

Preparations.—*Infusum Gentianæ Compositum.* (Not official.) Compound infusion of gentian. (Gentian, bitter orange-peel, coriander.) Dose, ʒ j—℥ j.

Tinctura Gentianæ Composita.—Compound tincture of gentian. (Gentian, bitter orange-peel, cardamom, alcohol.) Dose, ʒ ss— ʒ ij.

Extractum Gentianæ Fluidum.—Fluid extract of gentian. Dose, ʒ ss— ʒ ij.

Extractum Gentianæ.—Extract of gentian. Dose, gr. j—gr. v.

Composition.—Gentian contains a peculiar principle, *gentianine*, and an acid, *gentisic acid*.

Gentiana Catesbæi.—Blue gentian, American gentian. This indigenous remedy may be used as a substitute for the foreign gentian, and similar preparations to the official formula for gentian, as above, may be prepared from it.

Unofficial Formulæ.—*Mistura gentianæ alkalina.* Dilute hydrocyanic acid, ♏ iij; bicarbonate of soda, grs. xv; compound infusion of gentian to oz. j.

Mistura Gentianæ et Sennæ.—Infusion of gentian, drachms vj;

infusion of senna, drachms iij; compound tincture of cardamoms, drachm j.

Calumba.—*Colombe* (*racine de*), Fr.; *Ruhrwurzel*, Ger. The root of *Jateorrhiza calumba* Meiers (Nat. Ord. *Menispermaceæ*).

Preparations.—*Infusum Calumbæ.* (Not official.) Infusion of calumba (℥ j—Oj). Dose, ℥ ss—℥ ij.

Tinctura Calumbæ.—Tincture of calumba (100 grm. to 1,000 c. c. of diluted alcohol). Dose, ʒ ss—ʒ ij.

Extractum Calumbæ Fluidum.—Fluid extract of calumba. Dose, ʒ ss—ʒ ij.

Composition.—A peculiar principle, *colombin*, *berberine*, and a peculiar acid, *colombic acid.*

Coptis.—*Goldthread.* The root of *Coptis trifolia.* There are no official preparations of coptis. It contains, in common with some other bitters, the alkaloid *berberine*, and another alkaloid in minute quantity which has been called *coptine*, closely allied to, if not identical with, hydrastine. The tincture and fluid extracts are the best preparations.

Calendula.—The florets of *Calendula officinalis*, Linné (Nat. Ord. *Compositæ*).

Tinctura Calendulæ.—Tincture of calendula. Calendula, 200 grm., and alcohol q. s. to make 1,000 c. c.

Cornus.—*Dogwood.* The bark of the root of *Cornus florida* Linné (Nat. Ord. *Cornaceæ*).

Preparation.—*Extractum Cornus Fluidum.*—Fluid extract of dogwood. Dose, ♏ x—ʒ j.

Decoctum Cornus Floridæ.—(Not official.) Decoction of dogwood (℥ j—Oj). Dose, ℥ ss—℥ ij.

Antagonists and Incompatibles.—Quassia and calumba can be administered with the salts of iron. The sulphate of iron, and the silver and lead salts, are incompatible with gentian. The infusion of coptis is not affected by the salts of iron, but is precipitated by the nitrate of silver and acetate of lead. Therapeutically, all those agents which promote waste or destructive metamorphosis are opposed to the action of the simple bitters.

Synergists.—Iron, the mineral acids, pepsin, bismuth, etc., are synergistic to the bitters, and under some circumstances the alkalies promote their therapeutic action.

Physiological Actions.—The simple bitters increase secretion from the mucous membrane. In the mouth they promote the flow of saliva, and in the stomach they appear to stimulate the production of gastric juice, and also of gastric mucus. It follows that an increase of digestive capacity is one result of their administration. The increased appetite which is observed from the use of the bitters is probably due to two factors: the sense of bitterness which increases the desire for food, and the improved digestive power which, enabling more food to be disposed of, postpones the sense of satiety. Furthermore, the bitters, by removing morbid states of the intestinal mucous membrane, favor assimilation. More food being taken and more thoroughly digested, it is obvious that the bitters promote constructive metamorphosis.

The active constituents of some of them have been studied in detail. *Berberine*, which enters into the constitution of several bitters, is possessed of some antiseptic and antiperiodic power, but is not active from the physiological point of view. In animals it causes lowering of the blood pressure, and lessens body-heat (Curci). According to Köhler, it contracts the blood-vessels, and in the intestinal canal acts in a similar manner to the tannates. It is said, also, that when applied to the walls of the intestines they contract energetically. *Quassin* has recently been studied by Dr. Campardou, and his observations were published in a special memoir. There are, however, no new facts produced. Quassin, as might be supposed from its origin, acts after the manner of the bitter tonics ; it increases the appetite, and promotes the digestive functions by stimulating the secretions of the gastro-intestinal mucous membrane, and the contractility of the muscular fiber of the intestine. In an overdose quassin causes the local and systemic symptoms of an irritant poison.

Although these remedies, used judiciously and for a short period, undoubtedly promote the constructive metamorphosis, yet their long-continued use will produce gastric catarrh, decrease the flow of healthy gastric juice, and impair digestion.

THERAPY.—An infusion of coptis has much reputation in New England as a remedy in *aphthæ*, *psoriasis of the mucous membrane*, *ulcers*, and *epithelioma*, but it is probable that this supposed curative power is unfounded, and that it is no more useful than any bitter so applied.

A few drops of the tincture of calumba, or a teaspoonful of the infusion, will sometimes greatly relieve the *vomiting of pregnancy*, and is also occasionally efficacious in *sea-sickness*. The simple bitters are especially indicated in *atonic dyspepsia*, and in *chronic gastric catarrh*. They are useful in this state of things : pain after food, slow digestion, constipation, alternating with diarrhœa. Calumba is the mildest, and may be borne when quassia and gentian disagree. According to Wilson Fox, "calumba holds the chief place in point of therapeutic value as a remedy which can be safely employed when others of the class would be too irritating." When there are much relaxation and torpor, quassia is very useful as a stomachic tonic. Sometimes an extemporaneous cold infusion of quassia is used, made by filling overnight with cold water a quassia-cup—a goblet turned out of quassia-wood. When constipation exists in cases of atonic dyspepsia, good results are obtained by a combination of gentian with senna, as in the formula already given. The compound tincture of gentian is an excellent vehicle for the *administration of cod-liver oil*, and contributes to its digestion and assimilation.

The infusions of gentian, calumba, and quassia are usefully employed as vehicles for the administration of acids and alkalies in cases of acidity and deficient supply of gastric juice, under the rules given in the articles on acids and alkalies.

In *convalescence from acute diseases*, the simple bitters, especially gentian and calumba, are employed to promote the appetite and digestion, and thus to aid in the process of constructive metamorphosis.

In the *diarrhœa* which is due to relaxation of the mucous membrane, and is not dependent on inflammation, the tincture of calumba is often useful. The author has obtained good results from the use of tincture of calumba combined with opium in the treatment of an irritable state of the intestinal mucous membrane, indicated by these symptoms: Soon after taking food, the occurrence of pain referable to the small intestines, nausea, loose evacuations containing undigested aliments, and followed by weakness and depression. ℞ Tinct. calumbæ, ʒxv; tinct. opii deodor., ʒj. M. Sig.: A teaspoonful in a wineglassful of water before meals. Calumba is also serviceable in the relaxation of the bowels succeeding to acute affections of the intestinal mucous membrane.

The infusion of quassia is one of the most effective injections for the destruction of the *ascarides vermiculares* which infest the rectum. The stomach administration of simple bitters undoubtedly hinders the development of intestinal worms, probably by correcting a morbid state of the mucous membrane. In the treatment of intestinal parasites much good, therefore, is derived from the use of bitters, administered with the view of restoring normal digestion.

According to Wood, the remedy most effective to remove and "permanently cure a disposition to the *accumulation of flatus in the bowels* is an infusion made with half an ounce of calumba, half an ounce of ginger, a drachm of senna, and a pint of boiling water, and given in the dose of a wineglassful three times a day."

The bitters are used as remedies in *malarial fever*. Although they exercise but little influence over the course of intermittent and remittent fever, they are useful in the form of infusion as vehicles for the administration of more active drugs. In the convalescence from malarial fever, and in *chronic malarial poisoning*, they are more actively beneficial as agents promoting constructive metamorphosis. Calendula is chiefly used as a topical application in *chronic pharyngitis* and suppurative affections of the throat and external auditory canal. It has also been applied to the treatment of chronic stomachal disorders, catarrh of the stomach, of the duodenum, and conjoint implication of the bile-ducts. It was first introduced into medical practice by Dr. Sexton, of New York, by whom it is employed in suppurative inflammation of the ear, and given internally in cases of suppuration to obviate septic infection. While the local application seems beneficial, there is little reason to suppose that it has any influence over a systemic septic state.

AROMATIC BITTERS.

Serpentaria.—*Virginia snakeroot. Serpentaire de Virginie*, Fr.; *Schlangenwurzel*, Ger. The rhizoma and rootlets of *Aristolochia serpentaria* Linné, and of *Aristolochia reticulata* Nuttall (Nat. Ord. *Aristolochiæ*), U. S. P.

PREPARATIONS.—*Infusum Serpentariæ.*—Infusion of serpentaria (℥ ss—Oj). Dose, ℥ ss—℥ j. (Not official.)

Tinctura Serpentariæ.—Tincture of serpentaria (100 grm.—1,000 c. c.). Dose, ʒ ss—ʒ ij.

Extractum Serpentariæ Fluidum.—Fluid extract of serpentaria. Dose, ʒ ss—ʒ ij.

COMPOSITION.—A volatile oil, resin, a bitter principle, etc.

Prunus Virginiana.—*Wild cherry.* The bark of *Prunus serotina.*

PREPARATIONS.—*Infusum Pruni Virginianæ.*—Infusion of wild cherry (40 grm. and water to make 1,000 c. c.). Dose, ℥ ss—℥ ij.

Extractum Pruni Virginianæ Fluidum.—Fluid extract of wild-cherry bark. Dose, ʒ ss—ʒ j.

Syrupus Pruni Virginianæ.—Sirup of wild cherry. Dose, ʒ j—ʒ ij.

COMPOSITION.—Amygdalin and emulsin, which produce by their reaction hydrocyanic acid, tannic and gallic acids, etc.

Cascarilla.—*Cascarilla. Cascarille*, Fr.; *Cascarille Rinde*, Ger. The bark of *Croton eleuteria* Bennett (Nat. Ord. *Euphorbiaceæ*).

PREPARATIONS.—*Infusum Cascarillæ.* (Not official.) Infusion of cascarilla (℥ ss—Oj). Dose, ℥ ss—℥ j.

COMPOSITION.—A crystallizable principle, *cascarillin*, tannic acid, a volatile oil, etc.

Canella.—The bark of *Canella alba.* This remedy has been dropped from the list of official medicinal agents. As it is indigenous (Florida), and as recent experiences have shown that it is possessed of some valuable therapeutical properties, it is taken up now as a member of the group of aromatic bitters.

COMPOSITION.—Canella contains a volatile oil and a bitter principle, but the latter has not yet been isolated.

Actions and Uses.—These remedies possess the quality called tonic; they invigorate digestion, and promote constructive metamorphosis. They differ from the simple bitters in containing aromatic constituents, and in being astringent to a greater or less degree, owing to the presence of tannic and gallic acids. They are indicated in the same kind of cases as, and under similar conditions to, the simple bitters; but they are supposed to have, in addition, some specific properties derived from their volatile and odorous constituents.

Serpentaria is occasionally used as a stimulating tonic in *typhoid* and *typho-malarial fevers.* It is more frequently prescribed as a stimulant expectorant in *capillary bronchitis* and in *pneumonia* of low grade, when carbonate of ammonia is combined with it. Formerly it was used locally to the throat, as a gargle in *diphtheria*, and given internally as a stimulant, but it is now very rarely employed in such cases.

Wild-cherry is an excellent *stomachic tonic*, and may well be used as a substitute for calumba in the class of cases to which the latter is considered specially applicable. It has long been held in great esteem in domestic practice, as a remedy in *catarrhal states of the bronchial mucous membrane*, and in *phthisis.* Owing to the prussic acid which its cold infusion contains—produced by the reaction between the amygdalin and emulsin—it exercises some influence over cough. That it has any special virtues in the treatment of phthisis is hardly to be credited. The sirup is much used as an ingredient in cough-mixtures.

As regards canella, there has been no proper study of its physiological actions. The success which has, apparently, attended its use in certain hæmorrhagic states indicates that canella has properties analogous to erigeron : antiseptic, vaso-motor, stimulant, etc. Formerly, it was in considerable repute as a remedy for certain pelvic disorders in women, and was much prescribed in the form of *hiera picra* (vulgarly *hickery pickery*), *pulvis aloes cum canella.* Recently, Dr. Cheron has revived its use, and extols it much as a remedy for *menorrhagia* and *metrorrhagia* of chlorosis, for the menorrhagia occurring during pregnancy in weak, lymphatic women, for the menorrhagia of cancer, and for the persistent bleeding after delivery, due to the inefficient involution of the uterus, in some weak subjects. It is also often highly useful in the *dysmenorrhœa* of congestion, and the *amenorrhœa* of similar origin. If constipation coexist, the combination with aloes acts well.

Authorities referred to :

CHERON, DR. J. *Revue de Thérapeutique*, October 15, 1885, p. 350.

HUSEMAN, DRS. AUGUST UND THEODOR. *Die Pflanzenstoffe, op. cit.*

PORCHER, DR. FRANCIS PEYRE. *Resources of the Southern Fields and Forests*, Charleston, 1869.

OLEUM ERIGERONTIS.—A volatile oil distilled from the fresh flowering herb of *Erigeron canadense* Linné (Nat. Ord. *Compositæ*).

OLEUM ERECHTHITES.—A volatile oil obtained from *Erechthites hieracifolius* (fireweed).

I am informed by Prof. J. U. Lloyd, the distinguished pharmacist of Cincinnati, that the oil of erigeron is much adulterated with the oil of erechthites (fireweed). As these volatile oils have similar properties physiologically, there is probably no great harm done by the substitution. I am indebted to Prof. Lloyd for pure specimens of each. They differ in odor and in appearance. Erigeron-oil is reddish yellow in color, while erecthites is pale yellow, or nearly colorless.

Properties.—These oils are hot and somewhat pungent to the taste, and give off a characteristic odor. They grow darker in color, and thicker in consistence, by age. They are soluble in ether and in absolute alcohol. The principal constituent is a terpene.

The ordinary dose is five drops, or from three to ten drops, and the best mode to administer the oil is to drop the dose on a lump of sugar, and swallow with a large draught of water, or it may be put into gelatine capsules, or made into an emulsion with gum.

Actions.—Oil of erigeron has long been known to have considerable power to arrest hæmorrhage, but a knowledge of this fact has been confined to a few physicians of Philadelphia, and has not been acted on to any considerable extent. No adequate explanation has been offered of the nature of this property. Some recent investigations have satisfied me that the physiological actions consist in stimulation of the vaso-motor system, and at the same time of the inhibitory function of the vagus terminals. In consequence of these effects the amount of blood passing through the arterioles in a given time is much lessened.

Erigeron-oil, also, stimulates the renal functions, and promotes the cutaneous transpiration—both effects being due, probably, to contact with these organs during the process of elimination.

Oil of erigeron has considerable antiseptic power, prevents decomposition, and is destructive of microbes to some extent. There are other agents, however, more powerful as germicides, but under some circumstances erigeron-oil may be utilized for this purpose.

Therapy.—Recent experiences have confirmed former opinions that erigeron-oil has a distinct antihæmorrhagic property. In *menorrhagia* and *metrorrhagia* it has proved very effective in numerous instances, but it sometimes fails. In *purpura* it is distinctly beneficial. In fact, whenever hæmorrhage is more especially venous in character, in what site soever it may occur, erigeron is likely to do good.

The author has ascertained, also, that oil of erigeron is, in a high degree, useful in the chronic forms of *albuminuria*. It lessens the waste of albumen, sometimes remarkably, and at the same time improves the general condition of the patient. An acute congestion of the kidneys is probably a contraindication to its use, but in all the really chronic cases, united by the common symptom—albuminuria—it may be expected to render real service.

In catarrh of the genito-urinary mucous membrane, *pyelitis, cystitis*, etc., it has acted well, probably, because of coming into actual contact with the mucous membrane in the process of elimination. In small doses it has apparently allayed irritability of the bladder, as it occurs in women, and the author has seen it give much relief in cases of prostatic irritation.

As a *stimulant expectorant*, erigeron-oil is entitled to much consideration. It is nearly, if not quite, as useful in *chronic bronchitis, winter cough*, etc., as is terebene, and may be given under the same conditions, and to supply the same indications. Here, again, the explanation of its utility may be found in the actual contact with the diseased surface which takes place in the process of elimination.

Authorities referred to:

Bartholow, Dr. R. *The Physician and Surgeon*, Ann Arbor, April, 1887.

Eucalyptus.—Leaves of *Eucalyptus globulus* Labillardière (Nat. Ord. *Myrtaceæ*).

Preparations.—*Tinctura Eucalypti.* (Not official.) Tincture of eucalyptus. Dose, ʒ ss— ʒ ij.

Extractum Eucalypti Fluidum.—Fluid extract of eucalyptus. Dose, ♏ x— ʒ j.

Oleum Eucalypti.—Dose, ♏ v— ʒ ss. Usually prescribed in capsules, but may be given in the form of emulsion.

Composition.—Eucalyptus contains a peculiar resin composed of three different resinous bodies, a volatile oil consisting of *eucalyptol, terpene*, and *cymol*, tannic acid, and a crystallizable fatty acid. Eucalyptol is the most important of the constituents, and is now official.

Antagonists and Incompatibles.—Alkalies, the mineral acids, the salts of iron, mercury, lead, zinc, etc., are chemically incompatible. All agents promoting waste, or the retrograde metamorphosis of tissue, are therapeutically incompatible.

Synergists.—The simple and aromatic bitters, hydrastis, cinchona, etc., camphor, turpentine, cubebs, copaiba, the essential oils and substances containing them, are synergistic to or promote the therapeutical actions of eucalyptus. Any of these remedies may, therefore, be prescribed in the same formula with eucalyptus.

Physiological Actions.—Eucalyptus has a warm, aromatic, bitter, and camphoraceous taste, resembling somewhat the taste of cubebs. In the mouth it excites the flow of saliva, and leaves a hot, pungent, and rather disagreeable flavor. In the stomach it causes a sensation of warmth, and doubtless promotes the flow of gastric juice. The appetite and digestive power are increased under its use. Increased intestinal secretion, also, is one result of its administration, and hence the alvine evacuations are rendered somewhat more copious and easy. In very large doses it causes a sense of weight and uneasiness at the epigastrium, odorous eructations and indigestion, followed by diarrhœa, the stools having the characteristic odor of *eucalyptol.* The essential oil is readily diffusible and enters the blood with facility, but what changes, if any, it induces in the blood are unknown. It increases the action of the heart, lowers the arterial tension, and induces a feverish state. The respiratory movements are accelerated. Wakefulness is caused by it in those of full health, and sleep in the weak and anæmic. The eucalyptol is eliminated by the skin, mucous membrane of the bronchial tubes, and by the kidneys, the secretions of these organs being increased by it, and they are impregnated with its odor. This is especially the case with the urine, which, after some days' administration, becomes most strongly odorous by the presence of eucalyptol.

The vapor of eucalyptus, inhaled in large quantity, produces analogous effects to the internal administration, besides the more decided effects on the bronchial mucous membrane.

Eucalyptus is a powerful diaphoretic.

THERAPY.—The decoction of the leaves is an efficient local application in the various forms of *stomatitis*, *angina* subacute and chronic, and *tonsillitis* after the subsidence of the acute stage.

Eucalyptus is one of the most useful of the so-called stomachics in *atonic dyspepsia*, *chronic gastric catarrh*, and *chronic intestinal catarrh*, but its use is contraindicated in inflammatory states. The form of vomiting and indigestion dependent on the presence of *sarcina* is relieved by this agent, which acts by destroying the vitality of this minute organism. That condition of the mucous membrane which favors the production of *intestinal parasites* is removed by eucalyptus. In the case of *ascarides vermiculares,* the remedy should be used by injection.

Like the bitters, eucalyptus may be used to promote constructive metamorphosis, but it possesses more decided stimulant effects than these agents, by virtue of the eucalyptol. In *convalescence from acute disease*, in *debility* arising from defective assimilation, and in *cachectic states* generally, it is a serviceable tonic and stimulant. When the action of the heart is weak, it may be strengthened by eucalyptus. To women at the change of life who suffer from *flatulence*, *palpitation of the heart*, and *sudden flushings of the face*, it affords great relief, and often permanently removes these symptoms.

Hysteria, *chorea*, *asthma*, and allied nervous states, when occurring in debilitated subjects, and *cerebral anæmia*, are benefited by eucalyptus. In asthma eucalyptus may be smoked in cigarettes with stramonium, belladonna, tobacco, etc. Its efficacy in the form of fumes is strongly stated by Maclean.

The most important uses of this agent occur in the treatment of *catarrhal affections of the broncho-pulmonary mucous membrane.* It is not adapted to acute affections or to recent inflammation, but to chronic cases accompanied by free muco-purulent expectoration. The author is able to confirm the observations of Gubler in reference to the great utility of eucalyptus in *bronchorrhœa.* It is an interesting fact, and probably explanatory of its therapeutical action, that eucalyptol is in part eliminated by the bronchial mucous membranes. In the same way eucalyptus is effective in the treatment of *catarrhal states of the genito-urinary organs. Chronic desquamative nephritis, granular degeneration of the kidneys, pyelonephritis,* and *hydronephrosis,* are improved by its cautious administration, but it should not be forgotten that, used too freely, or for too great a length of time, it will cause irritation and congestion of the kidneys, in the same way that turpentine, copaiba, and cubebs do.

No remedy which the author has hitherto used has seemed to him so effective in *chronic catarrh of the bladder* as eucalyptus. The urine during its administration acquires a strong odor of eucalyptol, and to its local action on the mucous membrane is to be attributed the therapeutical effect.

Eucalyptus has been much praised as a remedy for *intermittent fever.* The evidence as to its utility is contradictory. As the result of his own observations, and after careful examination of the facts reported by others, the author concludes that eucalyptus is far inferior to quinine. It is certainly very serviceable in the *convalescence from intermittent and remittent fevers,* and in *chronic malarial poisoning* it has a high degree of utility. It can not take the place of quinine for the arrest of the paroxysms, or to prevent relapses at the septenary periods, but it is more useful than quinine to reconstruct the damages in the organs of assimilation caused by malarial infection.

Externally, the tincture and the distilled water of eucalyptus are used as disinfectant applications to *foul-smelling and ill-conditioned ulcers and wounds* (Gimbert). The water of eucalyptus is recommended by Gubler as a vehicle for agents used by the hypodermatic method. The toxic influence of eucalyptus on the lower forms of life—cryptogamic and infusorial organisms—is the ground of its application for these purposes. As respects solutions of alkaloids for hypodermatic use, the water of eucalyptus prevents the development of the *penicillium,* which grows rapidly and at the expense of the alkaloid in solutions prepared with simple distilled water.

Authorities referred to :

BURDEL, DR. E. *Bulletin de Thèrapeutique,* tome lxxxiv, p. 409, et ibid., tome lxxxv, p. 529.

COSTAU, M. *Gazette Hebdomadaire,* 1872, No. 25. *Bulletin de Thèrapeutique,* tome lxxxiii, p. 237.

GIMBERT, M. LE DR. *Bulletin de Thèrapeutique,* tome lxxxii, p. 422.

Gubler, Dr. A. *Bulletin de Thérapeutique*, tome lxxxi, pp. 145, 193.

Keller, Dr. *The British Medical Journal*, May 11, 1872.

Lorinser, Dr. *Wiener medicinische Wochenschrift*, 1869, xix, 43.

Maclean, Dr. M. C. *The Practitioner*, vol. vii, p. 268.

Schmidt's *Jahrbücher der gesammten Medicin*, vol. cxlviii, p. 11. *Ueber Eucalyptus globulus;* nach F. W. Lorinser; C. Haller; Franz Seitz; L. A. Buchner; C. Paul; A. Gubler.

Ibid. Vol. cl, p. 121. *Ueber den Nutzen des Eucalyptus gegen Wechselfieber.*

Hydrastis.—The rhizoma and roots of *Hydrastis canadensis* Linné (Nat. Ord. *Ranunculaceæ*). Yellow root.

Preparations.—*Extractum Hydrastis Fluidum.* Fluid extract of hydrastis. Dose, ♏v—℥ss.

Tinctura Hydrastis.—Tincture of hydrastis. Dose, ♏x—ʒj.

Glyceritum Hydrastis.—Glycerite of hydrastis. Hydrastis, 1,000 grm.; glycerin, alcohol, and water, q. s. to make 1,000 c. c. Dose, ♏v—♏xx.

Hydrastininæ Hydrochloras.—Hydrastinine hydrochlorate. The hydrochlorate of an artificial alkaloid derived from hydrastine, the alkaloid of hydrastis. It occurs in light-yellow amorphous granules, or a pale-yellow crystalline powder, odorless, and having a bitter saline taste. Soluble at 59° F. in 0·3 part of water. Dose, gr. $\frac{1}{40}$—$\frac{1}{10}$—$\frac{1}{6}$.

Composition.—Hydrastis contains a peculiar principle, *hydrastine* or *hydrastina*, which crystallizes in four-sided prisms, white or colorless when pure, and having but little taste. Hydrastine, the alkaloid, should not be confounded with the eclectic preparation, "hydrastin," which is composed chiefly of berberine.

Antagonists and Incompatibles.—The alkalies, tannic and muriatic acids, are chemically incompatible with the preparations of hydrastis. Muriatic acid precipitates *berberine*, and the so-called hydrastine of the eclectic practitioners is nothing more than berberine muriate. The alkaloid hydrastine is antagonized by chloral, which is, therefore, the appropriate remedy in poisoning by this agent.

Synergists.—The vegetable tonics in general are synergistic to hydrastis, especially *berberis vulgaris* and *calumba*, both of which contain berberine, and the group of excito-motors favor its action.

Physiological Actions.—The preparations of hydrastis have a decidedly bitter taste, and, like other bitters, promote the flow of saliva, and probably, also, of gastric juice. Increased appetite and digestive power result from its administration. It is, therefore, a *stomachic tonic.* It also increases secretion of the intestinal mucous membrane.

The property of hydrastis as a laxative is due to its effects on the various secretions concerned in the primary assimilation, whence the stools become softer, and to its stimulant action on the muscular fiber of the intestine, whence it increases peristalsis. Until the author's investigations were made in the laboratory of Jefferson Medical College, only vague impressions existed as to the character of its true active principle—*hydrastine.*

The most conspicuous effect of the alkaloid is the stimulation of the nervous system of animal life, and this power is exerted on cold- and warm-blooded animals, and on man in a uniform manner. Comparative tests demonstrated that the alkaloid and the fluid extracts, colored and colorless, acted in the same way—hence it follows that hydrastine is the true active principle, and that berberine contributes nothing to the impression made on the nervous system, although the stomachic tonic and cholagogue actions must be, in part, certainly referred to this alkaloid.

The most important and characteristic effect of the alkaloid—hydrastine—is that which it exerts on the nervous system of animal life; it is an excito-motor stimulant, and induces such a degree of excitability of the reflexes that the feeblest peripheral irritation causes general tonic muscular spasms, passing from above downward. Presently these tetanic convulsions occur independently, and in the interval between them more or less muscular trembling and paresis occur. This tetanizing action was found to be due to an impression on the spinal cord—is centric and not peripheral in seat. When very large doses are administered, the irritability of the motor nerves is destroyed and the muscular contractility impaired to some extent. Death ensues by tetanic fixation of the respiratory muscles, and hence increasing cyanosis and carbonic-acid narcosis occur.

In medicinal doses (medium) hydrastine stimulates the vagus, but lethal doses destroy its irritability, and the heart's action is arrested in the diastole, the cavities distended. It is then found that the cardiac muscular tissue will no longer contract on electrical stimulation. In ordinary medicinal doses hydrastine stimulates the vaso-motor system causes contraction of the arterioles, and raises the arterial tension accordingly, but in massive or lethal doses the opposite effects obtain.

Comparative experiments have shown that hydrastine not only has many points of correspondence in its physiological actions to strychnine, but its physiological antagonists are the same. The most important of the antagonisms is that between hydrastine and chloral. When the tetanizing action of the former is well advanced, chloral suspends the spasms, and thus prevents the tetanic fixation of the respiratory muscles, which is the mode of dying.

The elimination of hydrastine is effected chiefly by the kidneys, and to some slight extent, probably, by the intestinal glands.

THERAPY.—*Stomatitis,* both mercurial and aphthous, is much improved by local application of the fluid extract of hydrastis. When this preparation causes much smarting, it may be diluted with water. *Follicular pharyngitis, chronic coryza,* and even *syphilitic affections of the mouth, throat,* and *nares,* may be much benefited or even cured by the same application. It is said that five to ten drops of the fluid extract, taken by the stomach, will act favorably in the removal of the very troublesome affections named above, but the author is unable to verify these observations.

Hydrastis is very useful as a *stomachic tonic*, and may take the place of calumba in the treatment of *atonic dyspepsia*. A few drops of the tincture or fluid extract (five to fifteen) taken before meals, daily, for some time, will often cure *chronic gastric catarrh*, and remove the distressing headache which frequently accompanies this disease. It is one of the best remedies for the *stomach catarrh of chronic alcoholism*, and is probably the best substitute, if given in sufficient doses, for the alcoholic stimulant when its habitual use is to be abandoned. *Catarrh of the duodenum* is in a similar manner relieved by hydrastis, but this agent has special utility in duodenal catarrh when accompanied by *catarrh of the gall-ducts and jaundice*. Its use should, in these affections, be continued for some time.

These statements have been questioned by the authors of a dispensatory, the therapeutical part of which is chiefly remarkable for an elaborate nihilism. Quoting one of the foregoing sentences, the medical skeptic in question asserts that such confidence in the value of hydrastis indicates "marvelous virtues" in the remedy, or "still more marvelous faith" in those who make such assertions. It is unfortunate that mere library therapeutists should have the opportunity to air their crude conceptions and parade their uninstructed judgments in a big volume intended for the perusal of students and young physicians. The alkaloid hydrastine having the power to stimulate the motor centers of the nervous system, while it also acts on the gastro-duodenal mucous membrane, is peculiarly fitted to relieve that complex of conditions included in the term chronic alcoholism. It is the combination of these powers that renders it a valuable restorative when the use of alcohol is discontinued.

When *constipation* is dependent on deficient secretion, and the stools are dry and hard, it may be overcome by this remedy, but torpor of the muscular layer of the intestine is not affected by it.

Chronic catarrh of the intestine, even when it has proceeded to ulceration, is sometimes remarkably benefited by hydrastis. When the stools are very frequent and there is much pain, it is advantageous to combine a little opium with it. In *fissure of the anus*, *hæmorrhage from the rectum*, and *ulceration of the rectal mucous membrane*, applications of fluid extract of hydrastis to the affected parts promote healing.

As a remedy for *intermittents*, hydrastine ranks far below quinine. In chronic malarial poisoning (paludal cachexia), hydrastine may be given with ferruginous preparations, as quinine is so frequently employed. Although not without action, it is inferior to quinine in the condition of enlarged spleen of malarial origin.

Late researches have shown that berberine has an injurious effect on the kidneys, and must therefore be avoided; but hydrastine may be used with advantage in certain affections of the genito-urinary organs. In *chronic Bright's disease* it appears to lessen the excretion of albumen. It diminishes the mucus in *catarrh of the bladder*. It is often a useful remedy in *gonorrhœa* after the acute stage has subsided, and in *gleet*.

Hydrastine having the power to stimulate the excito-motor functions of the spinal cord, may be expected to do much good in cases of paresis or paralysis of motility when the lesions causing them are not recent in origin. Those forms of paralysis with trophic disturbances, which succeed to fevers and other acute affections, are conditions of disease in which it may be expected to do good. Reflex neuroses having their origin in gastro-intestinal catarrh, respiratory neuroses of a paretic character, and similar maladies requiring an excito-motor, will probably be successfully treated by hydrastine.

Prof. Schatz finds hydrastis a valuable remedy in the hæmorrhage of *uterine myomata*, in *menorrhagia*, in *congestive dysmenorrhœa*, and allied states. Its power to stimulate the organic nervous system, and thus to contract the blood-vessels, is Schatz's explanation of its mode of action.

The lethal quantity of hydrastine not having been determined, the dose can not be closely stated. It is probable that, beginning with $\frac{1}{20}$ gr., the dose may be increased up to $\frac{1}{6}$th or even $\frac{1}{2}$ grain.

LOCAL USES.—*Uterine and vaginal leucorrhœa*, *ulcerations*, and *erosions* of the *cervix uteri*, are quickly improved by the topical application of the fluid extract of hydrastis, which may be used in an undiluted state.

Unhealthy and *sloughing sores*, *chancroid*, old *ulcers* of the leg, are improved in character by the local use of this remedy.

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CINCHONA AND ITS PREPARATIONS.

Cinchona.—*Cinchona.* The bark of *Cinchona calisaya* Weddell, *Cinchona officinalis* Linné, and of hybrids of these and of other species of *Cinchona* (Nat. Ord. *Rubiaceæ*) containing not less than 5 per cent of its peculiar alkaloids, at least one half of which should be quinine.

Cinchona Rubra.—Red cinchona. The bark of *Cinchona succirubra* Pavon (Nat. Ord. *Rubiaceæ*) containing not less than 5 per cent of its peculiar alkaloids.

PREPARATIONS OF CINCHONA.—*Infusum Cinchonæ.*—Infusion of cinchona (cinchona, No. 40 powder, 60 grm.; aromatic sulphuric acid, 10 c. c.; water to make up to 1,000 c. c. Dose, ℥ ss — ℥ j.

Extractum Cinchonæ.—Extract of cinchona. Dose, gr. j—gr. x.

Extractum Cinchonæ Fluidum.—Fluid extract of cinchona. Dose, ♏ x — ʒ j.

Tinctura Cinchonæ.—Tincture of cinchona. Dose, ʒ ss — ℥ ss.

Tinctura Cinchonæ Composita.—Compound tincture of cinchona (red cinchona, bitter orange-peel, serpentaria, glycerin, alcohol, and water). Dose, ʒ ss — ℥ ss.

Alkaloids of Cinchona and their Salts.—*Cinchonina.*—Cinchonine. An alkaloid extracted from various species of cinchona.

Cinchoninæ Sulphas.—Cinchonine sulphate; occurs in hard, white, lustrous, prismatic crystals, without odor, and having a very bitter taste. It is soluble at 59° F. (15° C.) in sixty-six parts of water and ten parts of alcohol. Dose, gr. v — ʒ ss.

Cinchonidinæ Sulphas.—Cinchonidine sulphate. The neutral sulphate of an alkaloid extracted from the bark of various species of cinchona; occurs in white, silky, acicular crystals, and is soluble at 59° F. in seventy parts of water. Dose, gr. v — ʒ ss.

Quinina.—Quinine. An alkaloid obtained from the bark of various species of cinchona. A white, flaky, amorphous or crystalline powder, odorless, and having a very bitter taste. It is but slightly soluble in water—in 1,670 parts only. It is given in the form of various salts named below.

Quininæ Sulphas.—Quinine sulphate. Occurs in white, silky, light, and fine needle-shaped crystals. Soluble in 740 parts of water at 59° F. Dose, gr. j—℈j.

Quininæ Bisulphas.—Quinine bisulphate. Occurs in colorless, transparent or whitish orthorhombic crystals, or in small needles; odorless, and having a very bitter taste; soluble at 59° F. (15° C.) in ten parts of water and in thirty-two parts of alcohol. The aqueous solution has a strong acid reaction and a blue fluorescence. Dose, gr. v — ʒ ss.

Quininæ Hydrochloras.—Quinine hydrochlorate. Occurs in white, silky, light, and fine needle-shaped crystals; odorless, and having a very bitter taste. It is soluble in thirty-four parts of water at 59° F. (15° C.), and in three parts of alcohol. Dose, gr. j—℈j.

Quininæ Hydrobromas.—Quinine hydrobromate. Similar in physical qualities to the hydrochlorate, but is soluble in fifty-four parts of water at 59° F. (15° C.). Dose, gr. j—℈j.

Quininæ Valerianas.—Quinine valerianate. Occurs in white or nearly white, pearly, lustrous, triclinic crystals, having a slight odor of valerianic acid and a bitter taste. Soluble at 59° F. (15° C.) in one hundred parts of water and in five parts of alcohol. Dose, gr. j—℈j.

Composition.—Cinchona is remarkable for the number and variety of the principles obtained from it, viz., five alkaloids, two simple acids, two tannic acids, and a resinoid substance. The most important alkaloid is *quinine*, which exists in all varieties of bark, but is most abundant in the yellow or calisaya bark. It occurs in combination with kinic and kino-tannic acids. *Quinidine* is an alkaloid isomeric with quinine, and may be used as a substitute for the latter in the same dose. It is less bitter than quinine, and its sulphate is more soluble in water. *Cinchonine* is found in greatest quantity in the pale barks. It unites with acids to form salts, of which the sulphate is most frequently used. Therapeutically considered, cinchonine has about half the strength of quinine. *Cinchonidine* is an alkaloid isomeric with cinchonine, as quinidine is with quinine. *Aricine*, which has close analogies with cinchonine, has been found in the Arica or Cuzco bark.

The alkaloids are combined in bark with the acids *kinic* and *kinovic*, chiefly with the former. There are also two kinds of tannic acid, *kino-tannic* and *kinovi-tannic*, and a resinoid substance, *kinovin*. None of these have thus far been applied to therapeutical purposes, except kinic acid, which has been utilized to form a kinate of quinine, under the belief that a combination of quinine in its natural state would be more efficient as a remedy than as combined with a mineral acid.

When the mother-liquor, left after the crystallization of the alkaloids, is evaporated, a black residue is obtained, which is called *chinoidin*. This contains amorphous quinine and cinchonine, and probably also quinidine and cinchonidine. It is found in cylindrical sticks, is very bitter to the taste, brittle when cold, but plastic when warm; is but slightly soluble in water. Dose, gr. v—ʒ j.

With regard to the quantity of the alkaloids contained in the barks, respectively, it may be stated that the three varieties—pale, yellow, and red—differ only in the relative proportions of their constituents. The pale bark contains most cinchonine, the yellow most quinine, and the red an equal proportion of each.

Administration.—The alkaloids of bark are intensely bitter. Quinine being insoluble in the saliva, is less objectionable than its salts. The sweet principle of licorice covers the taste of the cinchona alkaloids. A sufficient dose of quinine may easily be inclosed in a chocolate caramel. The sugar-coated pill, when freshly prepared and by a reputable maker, is a convenient and suitable form for administration; but by keeping it becomes hard and insoluble. The most active form is a solution, the quinine being dissolved by the aid of sufficient dilute acid.

Antagonists and Incompatibles.—Substances containing tannic acid in a free state should not be administered with the *infusum* or *decoctum cinchonæ*. The preparations of iodine (tincture and compound solution) are also incompatible, for they form insoluble compounds with the cinchona alkaloids. The alkalies, alkaline carbonates, and alkaline earths should not be administered with the solutions of the alkaloids, because the latter will be precipitated.

As an agent promoting constructive metamorphosis, cinchona and its alkaloids are therapeutically antagonized by mercury, the iodides, the salts of copper, zinc, and lead.

As Gubler has shown, morphine and quinine are antagonists in respect to their effects on the brain. As regards their action on the sympathetic system, on the heart, and on the temperature, quinine, and belladonna and its alkaloid, are antagonistic.

SYNERGISTS.—All those agents which promote constructive metamorphosis, as the bitters, the ferruginous preparations, arsenic, and the acids, are synergistic to cinchona.

PHYSIOLOGICAL ACTIONS.—The preparations of cinchona are known as "astringent bitters": they contain, in addition to bitter principles, two tannic acids. As bitters they act as stomachic tonics; that is, promote appetite, the flow of gastric juice, and the digestive power. Long continued, as is the case with all the other bitters, they set up a gastric catarrh, and digestion becomes painful and labored. They differ from the simple bitters in exercising an astringent action on the intestinal mucous membrane, and cause constipation. The red bark is more decidedly astringent than the yellow or pale bark.

Since the time of Sir John Pringle, who made the first experiments on this point, cinchona has been known to possess antiseptic properties. The powdered bark, applied to unhealthy wounds, arrests putrefactive decomposition, and promotes healing. The alkaloids are destructive of the minute organisms, on the presence of which fermentative changes depend, and hence, when added to milk, urine, and other animal fluids, will prevent decomposition (Binz, Herbst, Baxter, etc.). Quinine, the most active of the alkaloids, is not equally destructive of all minute organisms: some, it merely inhibits; others, it kills. The bacteria of septic fluids resist its toxic action to a great extent, and are only inhibited by the largest quantity.

When the crude bark is introduced into the stomach, the alkaloids are dissolved out by the acid gastric juice, in which they are freely soluble. Any portion of the bark, or of the alkaloids, escaping solution in the gastric juice, probably, passes out with the other unabsorbed contents of the intestine. The alkaline reaction of the intestinal juices will cause precipitation of the alkaloids, which, forming insoluble combinations with the bile-acids, will not be absorbed. From the stomach the alkaloids diffuse into the blood with facility. In the alkaline blood, it is probable that the alkaloids are held in solution by the carbonic acid (Kerner). No changes visible by the unassisted eye are discernible in the blood, for, notwithstanding the observations of the older writers, who affirm that the blood was dark and uncoagulable, the moderns deny the existence of such alterations (Briquet, Schwalbe). Quinine acts in a definite manner on certain constituents of the blood—on the hæmoglobin, impairing its power to transport active oxygen or ozone, into which the ordinary oxygen of the air is converted. This is demonstrated in the following manner: Mix with old turpentine, that is, turpentine long exposed to the air, and therefore holding ozone, some tincture of guaiacum; if, now, some hæmoglobin or a drop of blood be added to the mixture, the tincture of guaiacum assumes a blue color, the change of color being due to the oxidation of the guaiacum by the active oxygen or ozone contained in the hæmoglobin (Hermann). The addition of certain substances, notably of quinine, prevents the reaction; in other words, destroys the ozonizing action of the blood. Binz has shown that so small a quantity of quinine as one part to twenty thousand exerts this action to a considerable extent. As soon as the blood is withdrawn from the peculiar influence exerted by the walls of the blood-vessels, as was some time ago shown by Pflüger and Zuntz, its alkalinity begins to decline, and presently it exhibits an acid reaction. Correspondingly with the progress of this acidification, A. Schmidt has shown that the quantity of contained oxygen diminishes and the carbonic acid increases. These changes, leading finally to the death of the blood, are greatly retarded by the addition of quinine (Schulte, Binz, Ransoné, Kerner). From these observations we draw the conclusion that quinine lessens the oxidizing or ozonizing function of the blood.

Binz and his pupils have shown that quinine inhibits or lessens the activity of the white blood-corpuscles, and indeed destroys them, or arrests their production; for, in cats poisoned by this agent, the number of white corpuscles was found to be considerably less than in unpoisoned animals (Scharrenbroich, Martin, Jerusalimsky, Geltowsky). By all the observers just named, by Baxter, who made a series of very carefully conducted experiments, and by Cutter, it has been established that quinine inhibits the amœboid movements of the white corpuscles. These bodies, as other masses of protoplasm, are in constant motion, changing their form and appropriating the materials of their nutrition. Such movements are called amœboid, and they are arrested by quinine, even in so small a quantity as one part to four thousand; hence it is called a protoplasmic poison. Quinine has also the power to prevent or arrest the migration of the white corpuscles from the vessels. This Binz was the first to demonstrate, using the method employed by Cohnheim for exhibiting the phenomena. This is now generally conceded, although denied by Schwalbe; but, as the observations of Geltowsky show, the quantity of quinine necessary to produce the result varies with the animal experimented on, and ranges from one part in four thousand to one part in eight hundred, outside of the body (Appert). No amount, short of a fatal dose, can affect the movements of the white corpuscles in the living warm-blooded animal, according to Geltowsky, who, therefore, holds to the same view as Schwalbe on this point. In opposition to the views of Binz must also be placed Schtschepotjaw, who has studied the effects of small quantities.

Quinine also affects the rate of movement of the heart. An important distinction exists between the action of small and large doses. It is a matter of daily observation that ordinary medicinal doses of quinine (from two to five grains) increase the action of the heart, while experiments with large doses have demonstrated that this agent depresses the circulation. Observations on the intra-cranial circulation, as seen through the retina and drum membrane, have demonstrated that an artificial hyperæmia results from the administration of medicinal doses. On the other hand, as Favier was the first to observe, quinine in large doses depresses the heart, arrests it in the diastole without impairing its contractility, and lowers the arterial tension (Chirone, Briquet). Quinine acts on the cardiac motor ganglia, and hence occur the feebleness of the heart's movements and in part the general lowering of the vascular tension (Lewizky). Besides these effects, it unquestionably depresses the vaso-motor system, after a short preliminary stimulation, probably (Jerusalimsky, Lewizky, Briquet). This depression of the heart from large doses occurs after the vagi are divided (Briquet, Schlockow, Köhler, Lewizky), and is more conspicuous when the agent is introduced into the jugular vein, indicating that the impression made on the heart is not through an increase of inhibition, but on the cardiac ganglia. Immersion of the heart in a quinine solution quickly arrests its movements.

In the normal condition of the human subject, quinine does not appreciably affect the temperature. In the course of some carefully conducted experiments a few years ago, I found that the maximum doses caused not more than a half-degree decline in a healthy adult. In fever, however, the influence of antipyretic doses is prompt and decided. This result may be attributed to several factors : to the depression of the heart and arterial tension, to the suspension of the oxidizing power of the blood, and to the inhibition of the white corpuscles. Jürgensen was the first to observe that quinine prevented the rise of temperature produced by certain physiological acts, as, for example, active exercise, but Kerner has more particularly developed the experimental evidence proving this fact. By active gymnastics, the temperature was found to be elevated two to three degrees Centigrade ; but the previous exhibition of a full dose of quinine prevented this rise of the body-heat. Kerner also ascertained that the increased cutaneous secretion, the result of active exercise, was prevented by the administration of sufficient quinine. From all of these facts, it seems evident that the lowering of the temperature by this agent depends on diminished production of heat rather than increased radiation and loss by cooling of the skin. This statement seems confirmed by the experiment of Lewizky, made in Hering's laboratory, by wrapping a rabbit in protective envelopes to prevent loss of heat by cooling, and then practicing the intra-venous injection of quinine ; the result was a depression of temperature as in animals not so enveloped. To such experiments, the author opposes the insuperable objection that the temperature in rabbits kept at rest declines, and to a remarkable extent, without the administration of any medicament. Nevertheless, the fact of the reduction of temperature by quinine is undoubted. By Popow, who admits the diminution of temperature, the influence of quinine over the body-heat is referred to some unknown biological process.

In small doses quinine exerts a distinct stimulant effect on the cerebrum, increases the mental activity, and even exhilarates in some mobile constitutions. As some hyperæmia is caused by it, the resulting cerebral stimulation is probably secondary to this change in the vascular condition. In full medicinal doses, as the quinine accumulates in the brain, a sense of fullness in the head, constriction of the forehead, *tinnitus aurium*, more or less giddiness, even decided vertigo, may be produced. Dullness of hearing results from considerable doses, and deafness has in rare cases been permanent. In a long experience of its use and extended observation, no case has come under my notice of permanently impaired hearing, although the temporary condition is usual. According to Knapp, Moos, and others, amaurosis is produced by very large doses. White atrophy of the optic disks occurs, and most of the vessels disappear from the field. This must be due to strong contraction of the vessels, since this condition is quite curable, the ordinary appearance of the retina being restored in most of the cases. Permanent atrophy of the optic nerve is, however, an occasional result. Amblyopia is frequently produced by the use of considerable doses kept up for some time. It is recovered from readily by suspending the administration of the remedy and taking the necessary steps to improve the intraocular circulation. In actually toxic doses all of the above symptoms have been intensified. There are intense headache with constriction of the forehead, dimness of vision or complete blindness, deafness, delirium or coma, dilated pupils, weak, fluttering pulse, irregular and shallow respiration, convulsions, and finally collapse and death. It is excessively rare to encounter such severe cerebral symptoms.

The influence of quinine over the functions of the spinal cord is yet *sub judice*. Chaperon some time ago demonstrated that quinine lessened and ultimately abolished the reflex function of the spinal cord. This result he decided was due not to immediate action on the spinal cord, but to stimulation of Setschenow's center of inhibition of reflex movements. Brunton, who has repeated Chaperon's experiments, has found them to be correct. The observation of Schlockow, that the first effect of quinine is to increase the sensibility of the reflex function of the spinal cord, has much probability in its favor. Heubach has also, after moderate doses, observed some evidences of the existence of reflex irritability, but the experiments of Brunton show that these reflex effects decline with the increasing stimulation of the inhibiting center. Brunton's experiments were also directed to ascertain whether the sulphuric acid in combination with the quinine was responsible for the effects observed, but the result proved that quinine is the active agent in stimulating Setschenow's inhibiting center.

As quinine depresses the functions of the sympathetic system, its action is opposed to that of agents which have the power to promote uterine contractions, hence, *a priori*, it would not seem to be abortifacient. Very numerous and conflicting statements have been put forth, because there are no exact data. The few cases in which uterine action followed the administration of quinine were, doubtless, due to malarial intoxication or to other causes, and hence the association of uterine action with the effects of quinine was accidental. The innumerable instances in which quinine has been given during the existence of pregnancy, without initiating contractions of the womb, are certainly conclusive against the view of its abortifacient power. While it is not a special uterine stimulant, it may exert such an action indirectly. When uterine inertia is due to depression of the vital forces, quinine, in moderate doses, then becomes a valuable stimulant, and is utilized for this purpose in obstetric practice.

The diffusibility of quinine and its rate and mode of elimination have been studied by Bence Jones, Ciotti and Albertoni, and Kerner. Jones in his researches availed himself of the fluorescent property of animal tissues, possessed also in a high degree by the alkaloids of cinchona, especially quinine. To this substance, as it appears in animal tissues, Jones gave the name "animal chinoidin," but he was not aware that fluorescence is a property possessed by large numbers of animal and vegetable bodies. Nevertheless, he recognized the fact that the diffusibility of quinine could be estimated by the increase in the fluorescence of animal textures, and he thus ascertained that in a half-hour after the administration of quinine a positive gain in fluorescence of the crystalline lens is observed. It is probable that under some circumstances—a catarrhal state of the mucous membrane, for example—a portion of the quinine taken fails to be absorbed, and is consequently excreted by the intestines (Byasson). The effect of this agent on the secondary assimilation is involved in more or less doubt. Opposing opinions have arisen from the different points of view taken. In the normal condition quinine, in small quantity, stimulates the nutrition, and increases the excretion of waste products—urea, uric acid, creatinin, extractives, etc.; but, in considerable doses, the opposite condition obtains—the decrease in the quantity of uric acid is especially well marked (Ranké, Kerner)—and when administered in malarial fevers all the products of waste are greatly increased. The conditions attending the use of the remedy, therefore, influence the result. Considerable doses in the normal state diminish the excretion of urea, uric acid, creatinin, and phosphoric and sulphuric acids (Kerner). Strassburg, however, failed to find any change in the carbonic acid. According to the observations of Cutler and Bradford, quinine has an obvious effect on the globular richness of the blood, increasing the relative proportion of the white, and diminishing the red globules. The action of quinine on the spleen is still *sub judice.* Piorry was the first to note a reduction in the size of the organ produced by quinine, but he had an exaggerated notion of the nicety by which a difference in the size of an organ could be made out by the plessimeter and hammer. Küchenmeister examined the subject experimentally in 1851, with negative results, but afterward, operating with larger doses, obtained confirmation of Piorry's view. Mosler, after dividing all the nerves of the spleen, ascertained that quinine in large doses still acted on the contractile elements, and reduced the size of the organ. Jerusalimsky, in an elaborate research, has established the same fact. That the enlarged spleen of malarial infection is reduced by quinine is an undoubted clinical fact. From these positive observations it must be concluded that quinine does act on the spleen, notwithstanding there are numerous negative statements. It follows, hence, that the diminution in the red and increase of the white corpuscles may be due to this action.

Quinine diffuses out of the blood into the urine, chiefly, but also into the sweat, saliva, milk, and pathological exudations (Kerner, Briquet, Binz). Jürgensen found quinine in the urine in ten minutes after the hypodermatic injection. Thau had evidence of its presence in the urine in a half-hour after the ingestion of a half-drachm dose each by two persons, and he holds that the maximum elimination takes place in about eight hours, but the excretion is not completed until two days after the administration. According to De Renzi, quinine remains in the organism a variable number of days, and may indeed be discovered in the urine on the third day; in a special case, as late as seven days. Binz also finds that the elimination of quinine is variable and rather slow, the maximum being excreted within forty-eight hours. From the time the agent appears in the urine, the systemic action is manifest, and the maximum effect of any given dose must be experienced in advance of the period of maximum elimination, which Thau places at eight hours. According to Kerner, quinine appears in the urine in a somewhat modified form.

The action of quinine has occasionally been attended by the appearance of an eruption on the skin. Sometimes the exanthem has been in the form of an erythema, sometimes it has assumed the appearance of urticaria; again, it has seemed to be herpetic. There is, in fact, no constant and invariable eruption, and many of the reported cases are open to the suspicion that the appearances on the skin are merely accidental, and not causative.

THERAPY.—A solution of quinine will sometimes, when applied to the nares, arrest an attack of *summer catarrh*, a malady which appears to be produced by the pollen of plants. The preparation most suitable for this purpose is an aqueous solution of the hydrochlorate (gr. iv—gr. viij—℥ j). This should be applied by a large camel's-hair brush, or spray-producer, to the nares and fauces. The utility of quinine in this peculiar disease will be determined by the extent to which the local trouble has proceeded; it can be useful only when the irritation is confined to the nares and fauces.

The *aphthous ulceration* (*muguet*) which succeeds to an exhausting entero-colitis, or which occurs in cachectic infants, is much improved by quinine—a grain or two every three hours. An attack of *acute tonsillitis* may sometimes be aborted by a full dose of quinine (ten to fifteen grains). This practice is especially indicated in those cases which proceed to suppuration, but the quinine must be administered before pus forms.

The preparations of cinchona are much used as stomachic tonics. In *atonic dyspepsia* they are employed, like the simple bitters, to promote the flow of gastric juice. In *gastric catarrh* they relieve that morbid state of the mucous membrane on which the increased production of mucus depends. For these purposes they may be combined with the mineral acids. The best preparation is the infusion; the decoction, although official, is inelegant and faulty. The alkaloid quinine is frequently used for the same purposes, and notably in the *gastric catarrh of drunkards*, combined with acids. When vomiting of yeast-like material is due to the presence of *sarcina*, quinine may be used in virtue of its power as a poison to these minute organisms, and as an anti-ferment. In these stomach-disorders other and less expensive drugs may be used with equal advantage. (*See* HYDRASTIS.) When there is a relaxed state of the gastro-intestinal mucous membrane, manifested by catarrh, diarrhœa, etc., but without inflammation, the preparations of red bark are more particularly indicated in virtue of the tannins which they contain. The reader need hardly be reminded that the preparations of cinchona are contraindicated in all inflammatory states of the intestinal mucous membrane. Furthermore, if too long continued, they will set up an irritation, and perpetuate the troubles which they were prescribed to remove.

Sometimes it happens that the *entero-colitis* of children (cholera infantum), which resists every possible combination of astringent and laxative, will yield readily to quinine. The author has seen quinine give prompt relief in the following: A child suffers with tenesmus, and after much straining voids a transparent mucus streaked with blood, but there is no fever nor other disturbance of the bowels, and the stools when passed are natural.

The preparations of cinchona and quinine are very serviceable in that state of the mucous membrane which favors the development of *ascarides*. After the expulsion of the parasites, these remedies remove the saburral state of the mucous membrane. A combination of purgatives and bitters will correct the following condition of things as they occur in children : A foul breath, coated tongue, capricious appetite, tumid belly, and constipation alternating with diarrhœa.

The use of quinine as a restorative tonic in cases of *debility* is almost universal. Given in moderate doses—six to twelve grains a day—it promotes constructive metamorphosis. Its utility is due not to any direct action on the blood, but to its stimulant effect on the digestive function, and the retardation of the combustion process. When cinchona or quinine proves irritant to the intestinal mucous membrane, this beneficial restorative action ceases. Iron and arsenic increase the power of quinine to promote construction of tissue and to retard waste.

There can be no doubt in regard to the power of quinine to arrest the *inflammatory process* in its formative stages. Its utility, given with this view, ceases when the migration of the white corpuscles and the proliferation of the cellular elements of the inflamed parts have taken place, for it possesses no power to cause disintegration and absorption of inflammation products. Administered at the critical moment, a commencing *fibrinous pneumonia*, a *pleuritis*, an *endocarditis*, may be suppressed by a full dose (twenty to forty grains). Its power in this respect is much increased by combination with morphine. If the time have passed for the use of quinine in this way, it is employed with advantage as a restorative tonic in the various inflammatory affections of low type, small doses (two to four grains) being given frequently.

In *septic diseases* quinine has very important uses. Although the observations of Binz, showing the influence of quinine over septic processes, may not be applicable to the full extent for which he proposes them, there can be no doubt of the good effects in practice of quinine in *septicœmia*, *pyœmia*, *erysipelas*, and *puerperal fever*. In these diseases, only large doses—five to twenty grains—every four hours, are useful.

The author's experience in the treatment of *acute rheumatism* does not justify the use of large doses of quinine, as now employed by Briquet and his followers in France. In the *hyperpyrexia* of acute rheumatism, it is true, large doses of quinine will depress the temperature, but we have less distressing and more effective means for accomplishing this object in the wet-pack and the cold bath. When the acuter symptoms have subsided, and the skin is cool and perspiring, and the pulse weak, quinine in moderate doses—two to five grains—is very serviceable.

A careful examination of the large number of facts which have now been accumulated, and considerable personal experience and observation, have satisfied the writer of the inutility of quinine as a means of aborting or shortening the duration of *typhus* and *typhoid fevers.* Not only has this remedy little or no influence over the course and duration of these affections, but its irritant effects upon the gastro-intestinal mucous membrane, and its inhibitive influence, exerted through the organic nervous system, upon the heart and lungs, may, in some cases, render it positively injurious in large doses. As a rule, the dryness of the tongue, the diarrhœa, the subsultus, and the delirium of typhoid fever, are increased by it. In certain parts of the United States, the prevalence of a mixed type—*typho-malarial*—requires, under certain conditions, the use of quinine in continued fevers. But it becomes less and less effective as the *typh-element* predominates. When there are evidently true remissions—and not merely the rhythmical morning remission and evening exacerbation characteristic of typhoid—quinine is indicated, and it is most effective when administered in an occasional large dose during the remission. When there is a condition of hyperpyrexia, or of continuously elevated temperature, which endangers life by parenchymatous degeneration and cardiac or cerebral paralysis, quinine in antipyretic doses renders an incontestable service. This opinion of the author is fully confirmed by the committee of the Clinical Society of London, who find that large doses of quinine have a marked effect in reducing the temperature in pyrexia, and that, although, with the exception, perhaps, of certain cases of rheumatic fever in which the temperature is high, no decided evidence has been obtained to show that quinine has any influence in shortening the attack of a specific disease such as typhus or scarlet fever, yet from the marked effect on the temperature and pulse there is reason to believe that at the critical stage of acute disease, when pulse and temperature are high, a large dose of quinine may be employed with benefit. Jürgensen, Ringer, Liebermeister, and other authorities, and a vast clinical experience in all civilized countries, are now agreed in respect to the fever-reducing power of quinine and to the absence of ill results from large doses (especially Liebermeister). Liebermeister, indeed, says, if he were restricted in his choice to one antipyretic, he would select quinine. The quantity necessary to effect a decided reduction of the body-heat in fevers is determined by the age, the amount of disturbance, and the individual susceptibility to its action. In general, it may be stated that from twenty to sixty grains will be required. The antipyretic effect is more decided if it is given toward the close of the exacerbation or during the remission in typhoid or other fevers. The duration of the effect is "from one to forty-eight hours"; consequently, a repetition of the dose will be necessary, if it is desired to maintain the reduction of the temperature.

A few large doses at short intervals until the necessary quantity is reached, or a single maximum dose if the stomach is tolerant, should be prescribed, rather than a succession of smaller doses. The rapidity with which elimination takes place is a sufficient reason for adopting the former mode of administration. The effect of quinine is not less happy in the fevers of childhood, and comparatively large doses are well borne at this period, as Jacobi, especially, has shown us. The same rule should be followed as in the case of adults: to give the amount required in several doses within a brief period—an hour, according to Liebermeister—or at one time. The antipyretic use of quinine should not be confounded with its tonic or supporting qualities. In the treatment of fevers, the typhoid state, or the condition of adynamia supervening during the course of fever, small doses (two, three, or four grains), at short intervals, are employed for the stimulating effects which they have on the organs of circulation, respiration, and digestion. Large doses, as has been set forth, depress these functions.

In *cerebro-spinal meningitis*, doubtless a continued fever with cerebro-spinal lesions, quinine is indicated under the conditions already defined for the treatment of other inflammations, viz., in the beginning of the disease, when the alterations of cutaneous sensibility first occur, and before the febrile movement has developed. If a few large doses—twenty to thirty grains—do not produce a good result, it is useless to repeat them, or to pursue a tentative plan with small doses.

In the treatment of the *eruptive fevers, variola, scarlatina, rubeola*, quinine has an important place. It is used in small doses, frequently repeated in adynamic states, and in large doses at longer intervals to reduce hyperpyrexia. In scarlet fever, Dr. Hood especially urges the use systematically of quinine from the earliest stage of the disease, preceded by an emetic and purgative, and he states as the result of this practice that since he has adopted it he has not lost a single case of this disease treated by him from the beginning. In measles, large doses of quinine have an unquestionable utility in relieving the catarrhal pneumonia, and in preventing those changes in the exudation products which end in caseation.

The treatment of malarial diseases by quinine is the most successful contribution ever made to practical therapeutics. No adequate explanation of its action had been offered before Binz suggested that its germicide power was the real source of its therapeutical activity. It was not, however, until Laveran discovered the flagellate organism and pigmented bodies which develop in the blood of those infected with malarial poison, that Binz's theory received support of a satisfactory kind. Laveran's discovery, made in 1881 in Algiers, has since been confirmed by Italian, French, and American pathologists, so that the long-sought cause of malarial infection may now be regarded as a known fact. The parasite consists of a pigmented body in the interior of the red blood-corpuscles—pigmented granules of various shapes free, and flagellate organisms, both having amœboid movements, the filaments of which engage in active vibration.

The alkaloids of cinchona are employed as *prophylactics* against *malarial infection.* The experience of the English naval service, of crews engaged on the coast of Africa in the suppression of the slave-trade, of the expeditionary force into Ashantee under Lord Napier, and of our late civil war, has abundantly shown that quinine is in a high degree prophylactic. The first public reference to this property seems to be that of Dr. Bryon in 1854, who called attention to the success which attended its use among the crews of the British vessels serving on the coast of Africa. Since that time, for several years the statistical reports of the British naval medical service have contained conclusive evidence on this point. Dr. Joseph Jones has published since the close of the civil war some valuable statistical data, showing the efficiency of quinine as a prophylactic. The troops who were the subjects of experiment were stationed in a highly malarious locality. Of the number, 230, who took no quinine, 134 had fever. Of those who took quinine irregularly, 246 in number, 96 had fever. Of the 506 who took quinine regularly, 98 had fever. The proportion of cases of fever was, therefore, 1 to 5·66 men. On the coast of Africa, the proportion has varied from 1 in 8 to 1 in 20. Of the unprotected, more than one half —on the coast of Africa, three fourths—were attacked by malarial disease in some form. As the quantity of quinine daily taken has been usually three to five grains, it is probable that the results would be even more favorable if a larger quantity of the prophylactic were given. When the poison is not intense, this amount may be sufficient, but if concentrated and active, and the conditions are otherwise unfavorable, twice as much should be administered daily. An enormous experience has now shown that quinine is entirely free from injurious effects when taken as a prophylactic. It is probable that the influence slowly decreases, and that some addition to the daily quantity may be necessary after a time. The prophylactic dose should be administered on rising in the morning, and may be usefully prescribed in a cup of black coffee, or in pill-form. The practice adopted in the civil war, of giving whisky as the vehicle, is not to be commended. If the quinine administered fail to prevent the disease, those attacked will suffer far less severely than the unprotected. Experience has shown that, to be entirely efficient, the quinine must be administered for some time, at least ten days, after exposure to the causes of fever (Jones).

The mode of using quinine for the cure of intermittents may be formulated as follows:

The antipyretic is nearly equally effective whether administered in the interval or during the seizure.

If time is an element of importance, no delay is necessary in order to give the remedy in the stage of apyrexia.

To save the suffering and exhaustion of the febrile movement, the attack should be anticipated, and, if possible, prevented.

As the maximum effect of the quinine is attained in about five hours after being taken, it should be administered this period of time, at least, before the expected paroxysm.

As the elimination of quinine takes place with considerable rapidity, the maximum curative effect is obtained by the administration of the whole amount required in a single dose, rather than by a succession of small doses (Prize Essay).

An intermittent may be successfully treated by giving, during the interval, a number of small doses frequently repeated. The author is convinced by extended observation that a full dose of quinine (ten grains) in the sweating stage, and the same quantity five hours before the time of the next paroxysm, is the more effective method. The anti-periodic property of quinine is increased, and the cerebral effects of large doses diminished, by combination with morphine. It is well known that intermittents, arrested by quinine or other anti-periodics, manifest a tendency to recur about the septenary periods ; therefore, ten to fifteen grains of quinine should be administered in anticipation of these recurrent paroxysms, until the third septenary period has passed. Meanwhile, the organs damaged by the malarial infection—intestinal canal, liver, spleen, kidneys, etc.—require appropriate treatment. The action of quinine is much assisted by the continuous administration of arsenic during the intermissions, and until the third septenary period has passed. The unpleasant cerebral effects of quinine are lessened or prevented by the simultaneous administration of diluted hydrobromic acid : ℞ Quininæ sulph., ʒj ; acid. hydrobromic. dil., ʒij ; aquæ, ʒxiv. M. Sig. : One or two teaspoonfuls at a dose.

In the treatment of *remittent fever* two modes of using quinine are employed : first, by emetics, purgatives, baths, diaphoretics, etc., to secure a distinct remission when the remedy is administered ; second, to give it in sufficient dose immediately, relying on its apyretic effect. The author is convinced that the latter plan is preferable: from twenty to thirty grains in a single dose once or twice each day until the temperature is reduced to normal. This use of the remedy need not interfere with other appropriate medication.

In the so-called *pernicious fever*, it is agreed on all hands that the safety of the patient is secured only by the prompt use of large doses (twenty to sixty grains), and administration by the stomach, rectum, and skin may be in turn or simultaneously resorted to.

In *chronic malarial infection*, important changes have been produced in the intestinal canal, liver, spleen, kidneys, cerebro-spinal axis; the paroxysms of fever occur irregularly ; various abnormal manifestations of the infection take place (dumb ague, enlarged spleen, etc.). Under these circumstances, quinine is less curative than when the infection is recent, and the paroxysms will recur from time to time notwithstanding its use, unless these structural alterations are corrected. In chronic malarial disease, salicylate of quinine and salicylate of cinchonidine are especially effective. ℞ Cinchonidinæ salicylat., ʒ ij; acidi arseniosi, gr. j; ferri sulph. exsic., ℈j. M. Ft. pulv. (wafers) no. xx. Sig.: One three times a day. Also: ℞ Chinoidin., ʒ ij; quininæ salicylat., ʒ j; ferri sulph. exsic., ℈j. M. Ft. pil. no. lxxx. Sig.: Two pills three times a day. ℞ Quininæ sulph., chinoidinæ, āā ʒ j; res. podophylli, gr. v; ferri sulph. exsic., ʒ ss. M. Ft. pil. no. lx. Sig.: Two pills three times a day.

In *periodical affections of malarial origin*, quinine is equally as effective as in the periodical febrile diseases, but somewhat larger doses are necessary. A difficulty of diagnosis often arises in these diseases, for the reason that the neuroses are irregularly periodical in their manifestations, when not malarial in origin. The existence of a malarial cachexia, and the more uniform periodicity in the recurrence of the paroxysms, will enable the practitioner to distinguish the neuroses of malarial origin from the other functional disorders of the nervous system. The following group contains the disorders of the sensory nervous system caused by malaria: tic-douloureux, cephalalgia, cervico-brachial neuralgia, cervico-occipital neuralgia, dorso-intercostal neuralgia, lumbo-abdominal neuralgia, mammary neuralgia, crural neuralgia, gastralgia, enteralgia, hepatalgia, nephralgia, hysteralgia, ovaralgia, sciatica, angina pectoris. The following motor disorders, also, are produced by malarial influences: epilepsy, chorea, stricture of urethra, hiccough, laryngismus stridulus, asthma, summer catarrh. These neuroses may occur as an expression of malarial infection, being substituted for the ordinary chill, fever, and sweat, or they may assume the orderly periodical character in consequence of having occurred in an organism already under the influence of the malarial cachexia. If they are of malarial origin, the specific action of quinine will speedily prevail against them. These malarial neuroses require large doses of quinine, and the same fact is true of all irregular manifestations of malarial infection. Ten to twenty grains, according to the severity of the attacks and the obstinacy with which they recur, are necessary, and the paroxysms should be anticipated by the exhibition of the remedy from three to five hours before the expected time. In cases of malarial neuralgia, the curative effect of quinine is enhanced by combination with morphine, either in the same prescription or by simultaneous administration of the latter subcutaneously.

Diarrhœa, dysentery, jaundice, and hypertrophy of the spleen occasionally occur in the periodical form, or are due to the immediate influence of paludal miasm. Under these circumstances quinine affords relief without the use of any other remedy. Very frequently the diarrhœa, dysentery, and jaundice are results of structural alterations in the liver and the glandular apparatus of the intestine, and are not merely functional disorders which quinine may remove. In malarial enlargement of the spleen, quinine is supposed to be especially effective; but quinine exhibits a curative power only in cases of simple enlargement, and does not affect that condition known as "fleshy spleen," or chronic splenitis, of inflammatory origin.

Hæmaturia, when distinctly intermittent and arising from malarial infection, is cured by quinine, but large doses are necessary. According to Karamitsas, sometimes hæmaturia is caused by this agent.

Cases of *cerebral disease*, occurring in weak and anæmic subjects, are sometimes much improved by small doses of quinine. The author has observed great relief by the use of this remedy in the following group of symptoms, occurring in men advanced in life: Headache, vertigo, failure of memory, and despondency, associated with a slow pulse, an atheromatous degeneration of the vessels, puffiness of the eyelids, and dilatation of the superficial veins of the head. From three to ten grains daily may be given with advantage, the effect being to remove that sluggishness of the intra-cranial circulation on which these symptoms depend. In *insanity*, especially the *puerperal form*, when there is much weakness, and the skin is cold and sweating, quinine is very useful. When there is a condition of adynamia—the usual state—in *delirium tremens*, small doses of quinine assist materially in tranquillizing the patient. In that preliminary stage known as "horrors," characterized by restlessness, tremor, nausea, and anorexia, quinine, with a mineral acid, renders important service by restoring the digestive function, and by giving steadiness to the cerebral motor centers.

Although headache (hemicrania) and neuralgia of malarial origin are cured by quinine, by no means equally successful results follow the use of this remedy in ordinary headache and neuralgia. Quinine is largely employed, it is true, in these affections when not caused by malaria, but it is useful only when anæmia is present and is causative. The same remark is true of *epilepsy* and *chorea*.

An attack of *acute catarrh* may often be entirely aborted by a full dose (ten grains) of quinine and morphine (one half a grain), if given at the incipiency of the attack. After the acute symptoms have subsided, quinine is very serviceable in *hay-asthma*. *Diphtheria* being an adynamic disease, quinine is used by the stomach with a view to its restorative action, and in the form of spray to arrest the spread of the exudation in the fauces. The power of quinine to kill bacteria and micrococci renders its local use a rational measure in a disease characterized by an enormous multiplication and diffusion of micrococci.

Laryngismus stridulus, a reflex spasm of the muscles of the larynx occurring in rickety, ill-fed, and anæmic children, may be prevented recurring by the use of quinine in the intervals between the attacks. Quinine is one of the remedies which is used in *membranous croup*, but the reported successes were probably cases of spasmodic croup. There can be no doubt regarding the good effects of quinine in *asthma*, after the severity of the paroxysms has somewhat abated, as an apyretic in the fever which succeeds, and as a restorative tonic. It is also the most useful tonic which can be employed in *chronic bronchitis*, with profuse expectoration (bronchiectasis). The hectic fever and sweats of *phthisis* are prevented by large doses (fifteen to twenty grains) of quinine, but this remedy really has no influence over the course and progress of the disease.

In *skin-diseases*, when there is present a lowered condition of the vital forces, quinine is indicated. It is the most valuable remedy in *erysipelas* and *erythema nodosum*. It is a curious fact that in many subjects a full dose of quinine will cause an erythema, with dilated pupils, phenomena closely analogous to those produced by belladonna. *Ecthyma* and *impetigo*, usually arising in a feeble state of the assimilative functions, are cured by quinine.

Quinine is largely employed in *surgical affections*, to sustain the powers of life during protracted suppuration, and to check the formation of pus. It is the most generally prescribed remedy for *surgical fever*. A full dose of quinine, given before the operation, may prevent the chill and fever which succeed in some subjects to the operation of *catheterization*.

Subcutaneous and Local Uses of Quinine.—The increasing use of quinine hypodermatically requires further consideration of this subject. In *pernicious intermittents and remittents*, when life is put in imminent danger, the most speedy and effectual way of introducing the remedy must be employed. Besides the hazards due to the intensity of the poison, an irritable stomach and rectum prevent the introduction of the remedy by either of those channels. The subcutaneous method then becomes most important. Again, in obstinate and repeatedly relapsing intermittents, the introduction of the remedy by the skin imparts to it greater curative power. In *enlarged spleen* (ague-cake), *malarial jaundice*, with great irritability of the stomach, and a catarrhal state of the gastro-intestinal mucous membrane, the subcutaneous method becomes necessary, or, if not essential, is much more effective. Quinine and the sulphate simply suspended are not adapted to subcutaneous use. Several cases of tetanus have been reported from New Orleans (Sale), and two cases occurred in one regiment of the British Indian Army from their use in this way. The salt employed for hypodermatic use should be sufficiently soluble that no undissolved particles be thrown under the skin. Various solutions have been proposed. The muriate is more soluble than the sulphate — dissolves in twenty-four parts of cold water, and about three parts of alcohol. One grain will dissolve in about fifteen minims of hot water, and in a much less quantity of alcohol-and-water, but alcohol is irritating. Lente's solution, which is much employed in New York, is prepared as follows: ℞ Quininæ disulph., grs. l; acid. sulphuric. dil., ♏ c; aquæ font., ℥ j; acid. carbolic. liq., ♏ v. Solve. This contains six grains to the drachm. Dr. Lente directs that the quinine and water be heated to the boiling-point when the acid is added. The solution is then filtered into a bottle and the carbolic acid added. Below 50° Fahr. it must be warmed before using. A solution of kinate of quinine is much used at Guy's Hospital at the strength of one to four. The kinate is obtained by decomposing sulphate of quinine with the kinate of barium. The mode of preparing the solution is as follows: Put into a beaker ʒ vj of distilled water and ʒ ij of kinate of quinine, and heat until the salt dissolves, which it does almost immediately, and then add enough distilled water to make up to ℥ j. The disadvantage of so concentrated a solution is the incrustation, by evaporation, of the bottle and syringe with the solid kinate. The sulpho-vinate of quinine is very soluble—one part in three of water at 60° Fahr.—and is readily prepared by double decomposition between the alcoholic solutions of sulpho-vinate of sodium and sulphate of quinine. Gubler advocates the hydrobromate, as follows: ℞ Quininæ hydrobromat., grs. xlviij; aquæ destil., f ℥ j. M. Dissolve by heat if necessary. Ten minims contain one grain.

Recently a new compound salt of urea and quinine has been proposed, and it seems to possess distinct advantages over every other preparation: it is designated *quinia bimuriatica carbamidata*, and is formed by Drygin from a combination of twenty parts of muriate of quinine, twelve parts of muriatic acid, and three parts of urea. The resulting salt is soluble in equal parts of water. The utility of this compound is not entirely theoretical. Practical trials made at Hamburg have demonstrated its fitness for hypodermatic use. A fifty-per-cent solution has usually been employed, and a half to three syringefuls (♏ xv to ʒ jss) injected. The local irritation is represented as slight. Very favorable reports have been published in respect to the utility of the hydrobromate brought forward by Gubler. In the hands of Raymond, Soulez, and others, intermittents are said to have ceased after two injections of three grains each of this salt. The usual method pursued was to inject one and a half grain of the hydrobromate twice morning and evening, and, although six to twelve grains were usually successful, in one case thirty grains were required. It has also been employed in the treatment of acute rheumatism.

Quinine in solution is applied in various affections of the fauces by atomization. In *diphtheria* especially have good results been produced.

A saturated solution of the muriate or of the bromide may be thus employed. There can be no doubt that a solution of quinine applied to the nares may be very beneficial at the onset of *hay-asthma*, as first shown by Helmholtz. The author has seen several cases benefited greatly; but to achieve success the applications must be thorough and timely. The secret of any good effects it has, is afforded by its toxic action on germs, and possibly on the pollen of certain grasses, to the presence of which the irritation of the air-passages is ascribed.

The author is indebted to Dr. W. R. Gray, of Orange, New Jersey, for a private communication in which he states that he has successfully used quinine by inunction—℈j of quinine to ℥j of lard—in the case of children especially. The ointment should be thoroughly rubbed in over the abdomen and at the flexures of the joints.

Orexine.—When first employed as a stomachic tonic it was administered in the form of the hydrochlorate. This proved so unpleasant in its effect on the stomach, and vomiting was so often induced by it, that it fell into discredit. It was then ascertained by Prof. F. Penzoldt that if given in the basic form—that is, uncombined—it could be readily taken without any unpleasant after effects.

As *phenyldihydroquinazoline*, it occurs as a white powder, which is soluble in hot water. It may be placed on the tongue and swallowed with water without giving rise to any pungent sensation or causing nausea. It may be given in wafer, or capsule, or in an ordinary pill mass, the dose ranging from two to five grains, an hour or two before meals.

Orexine is a stomachic tonic, in regard to which there is remarkable unanimity of opinion. It promotes appetite, occurring as a symptom in a great variety of affections. It appears to be contraindicated in stomach ulcer. It has proved useful in the anorexia of nervous subjects, in hysteria, in neurasthenia, and allied states. The author has found it most beneficial as a stomachic tonic in many neurasthenic subjects, otherwise difficult of management. The reports as to its utility in the vomiting of pregnancy have also been highly favorable.

While orexine is thus useful as a stomachic tonic, in the direct sense, it has proved beneficial, indirectly, as a means of improving the nutrition in various wasting diseases, as in tuberculosis, chronic gastro-intestinal catarrh, and similar maladies. It may, therefore, be administered when it is desirable to promote constructive tissue metamorphosis, when from impaired appetite the requisite amount of aliment can not be taken, and it can be used also when the stomach is functionally deranged by a reflex impression, as in the case of the vomiting of pregnancy. The range of its utility is therefore wide and varied.

Orexine Tannate has been proposed as a substitute for the basic orexine and for the hydrochlorate. Its chemical designation is phenyl-dihydroquinazoline tannate. It has the advantage of being an odorless and tasteless yellowish-white powder. It has been used with much advantage in promoting appetite and improving nutrition in various diseases—in phthisis, cardiac affections, after surgical procedures, and the vomiting of pregnancy. This preparation is contraindicated in the same conditions as the basic orexine when there is excessive acidity, and in ulcer.

Quinine and Urethan.—It has been lately ascertained that the hydrochlorate of quinine and urethan (ethylic), triturated together with a small amount of water, make a transparent, permanent solution, which may be utilized for the stomachal and subcutaneous administration of quinine. The following formula should be used: ℞ Quininæ hydrochlorat, ʒj; urethan (ethylic), ʒss.; aquæ destil., ℥j. M. Sig.: Dose, from ten minims upward. This solution is free from irritant qualities, and the urethan, by its sedative effect on the nerve centers, moderates the unpleasant effects of the quinine. The chief advantage of this combination exists in the facility with which quinine may be administered hypodermatically. It is necessary to note that it is only the hydrochlorate of quinine that urethan will act on as a solvent, and it is in about the proportion given above that a perfect solution is effected.

AGENTS PROMOTING DESTRUCTIVE METAMORPHOSIS OR INCREASING WASTE.

ALKALIES.

Potassium.—PREPARATIONS: *Potassa.*—Potassa; *potasse*, Fr.; *Kali hydricum*, Ger. Caustic potash. Occurs in cylindrical rods, is very deliquescent, and dissolves in water and in alcohol.

Potassa cum Calce.—Equal parts of potassa and lime. Escharotic.

Potassii Acetas.—Potassium acetate. A white, deliquescent salt, wholly soluble in water (100 in 35) and in alcohol (proof spirit 1 in 2). Dose, gr. v—℈j.

Potassii Bicarbonas.—Potassium bicarbonate. In white crystals, permanent in the air, wholly soluble in water (1 in 3), and having a slightly alkaline taste. Dose, gr. v—℈j.

Potassii Carbonas.—Potassium carbonate. A deliquescent salt, wholly soluble in water (100 in 75). Dose, gr. ij—gr. x.

Liquor Potassii Citratis.—Solution of potassium citrate. Dose, ʒj—℥j.

Potassii Citras.—Potassium citrate. A whitish, granular, deliquescent salt, wholly soluble in water (10 in 6). Dose, gr. v—ʒss.

Potassii Citras Effervescens. — Effervescent potassium citrate. Citric acid, 63 grm.; potassium bicarbonate, 93 grm.; sugar, 47 grm. Dose, a teaspoonful or two.

Potassii et Sodii Tartras.—Potassium and sodium tartrate; Rochelle salt. In colorless, transparent crystals, which effloresce slightly in dry air, and are wholly and readily soluble in five times their weight of boiling water. Soluble in cold water, 1 in 2.

Liquor Potassæ.—Solution of potassa. A colorless liquid, having an extremely acrid taste and a strong alkaline reaction. Dose, ♏ ij—♏ xx. It should be taken well diluted with water.

Potassii Chloras.—Chlorate of potassium. In colorless, lustrous, monoclinic prisms or plates, or a white powder, wholly soluble in distilled water (in cold water, 1 in 16·5; in boiling water, 1 in 2). Dose, gr. v—gr. xv.

Trochisci Potassii Chloratis.—Potassium chlorate troches.

Potassii Nitras.—Potassium nitrate. In colorless, prismatic crystals, unalterable in the air and wholly soluble in water (in cold water, 1 in 4; in boiling water, 1 in 2¼). Dose, gr. ij—gr. x.

Potassii Bichromas.—Potassium bichromate. In orange-red, anhydrous, tabular crystals, soluble in ten parts of cold and in much less of boiling water, forming a solution having an acid reaction. Dose, gr. ⅛—gr. ss.

Potassii Bitartras.—Potassium bitartrate; cream of tartar. Is sparingly dissolved in cold water (1 in 210), more freely in boiling water (1 in 15). Dose, ℈j—℥ss.

Potash salts not included in this list are considered elsewhere, in accordance with their physiological relations.

Antagonists and Incompatibles.—The alkalies and their carbonates are incompatible with the acids and with metallic salts. The caustic alkalies decompose the alkaloids of belladonna, stramonium, hyoscyamus, duboisia, etc. In case of poisoning, the antidotes to be employed are—acetic, citric, or tartaric acids, in the form of vinegar, cider, lemon-juice, etc.

Synergists.—The alkalies assist each other's action. All agents promoting waste—for example, mercury, the iodides, etc.—increase the therapeutical activity of the alkalies.

Physiological Action of the Potash Salts.—The most recent experiments having shown that potash has quite distinct properties from the other alkalies of the group, each member of the group is considered separately. As an alkali, potash combines with acids to form salts, and with fats to form soaps. As it has a great affinity for moisture, and dissolves albumen, and is a very diffusible substance, it exerts a destructive action on the animal tissues. These chemical facts explain the active caustic properties of potassa fusa. In the stomach the salts of potash obey chemical laws, neutralize the free acid, and saponify oily or fatty matters. Given when the stomach is empty, potash, as do the alkalies in general, promotes the acidity of the gastric juice, by increasing the diffusion of those constituents of the blood from which the acid of the stomach is elaborated; but, as a large amount of alkali will neutralize a corresponding proportion of acid, it is obvious that, to obtain an increased quantity of acid gastric juice, the amount of alkali administered must be small and rightly timed.

When a toxic dose of potassa, of the carbonate, nitrate, or chlorate, is taken, violent local inflammation results. The action and the appearances are somewhat different as regards potassa and its salts. The former liquefies the tissues, and extends its escharotic action widely and deeply, the sloughs being surrounded by a zone of inflammation. The salts, according to their activity and the quantity taken, set up a high degree of inflammation, cause intense burning pain about the epigastrium, nausea, vomiting, sometimes of bloody mucus, purging, the stools being watery and profuse, or they may be dysenteric. In the case of caustic potash, marks of corrosive action, sloughs of the mucous membrane, bloody oozing, may be seen about the lips, mouth, and fauces, and shreds of bloody and sloughing tissues vomited. In case of toxic action of potassa and its salts, the local destruction, pain, and inflammation are accompanied by the usual systemic symptoms—great depression of the powers of life, a weak, rapid pulse, shrunken countenance, cold surface, followed by coma and insensibility. In a small proportion of cases the local mischief is not great, but the effects of the poison are expended on the nervous system, and assume the form of muscular weakness, paralysis of the inferior extremities, weak action of the heart, and coma, and a very large dose may cause death suddenly by paralysis of the heart before the local inflammation has time to develop. The nitrate and chlorate are the most active of the salts, but all potash bases have more or less power in the same direction. The well-known case of Dr. Fountain, of Iowa, illustrates some points in the action of chlorate of potassa. Entertaining some theoretical notion of the curative power of this remedy when administered in considerable doses, he took an ounce to demonstrate its innocuousness. Violent gastro-enteritis was produced; at first there was free diuresis, but urinary suppression followed, and death ensued in seven days after the ingestion of the poison. When recovery takes place after poisoning by caustic potash, deformity of the mouth, stenoses of the œsophagus, cardia and pylorus, may remain, and then, after a partial improvement, the mechanical interference with the functions of these organs causes a more or less rapid marasmus.

When the alkaline bicarbonates are taken on an empty stomach they diffuse quickly into the blood, where, meeting the neutral phosphate of sodium, they are decomposed, acid phosphate of sodium being formed, and this compound, diffusing out of the blood into the urine, increases the acidity of that excretion (Rolfe). The result is different when bicarbonate of potassium is taken during digestion, for then, the reaction of the gastric juice being strongly acid, this salt is decomposed, carbonic acid is given off, and the alkaline base lessens the acidity of the stomach, increases the alkalinity of the blood, and diminishes the acidity of the urine. The salts of potash formed with vegetable acids undergo conversion into alkaline carbonates in their passage through the organism, and are eliminated in this form, thus causing an alkaline condition of the urine. The period of administration unquestionably influences the result to a large degree, as has just been stated. The increased alkalinity of the blood, produced by the administration of the potash salts, promotes its oxidizing function (Buchheim, Basham, Köhler, and others). The relative quantity of uric acid is diminished, and of urea increased. Basham, instructed by the observations of Schunck, that oxalurate of ammonia is a product of the oxidation of uric acid, and that the former is readily converted into urea and oxalic acid, holds that the same process takes place in the organism when uric acid is subjected to the action of the potash salts. The urine of patients suffering from uric-acid deposits was carefully examined after a course of the citrate or carbonate of potassium, and it was found, after an interval of about three days, that the urea was in one case trebled in amount, and in others more than doubled, while the uric acid was reduced to a fractional part of what had existed (Basham). The facts, then, are conclusive in regard to the increase in the oxidation processes, caused by the administration of potash, and its salts formed by combination with carbonic and the vegetable acids. The changes in the fatty constituents of the blood consist, probably, in a process of saponification and excretion. Nitrate and chlorate of potassium produce very different effects on the blood. Not parting with their oxygen in the system, and excreted undecomposed, the effects noted in the blood must be due to their action as a whole. The changes made by the chlorate in the composition of the blood have been studied recently by Marchand, in cases of poisoning in man and by experiments on animals. The blood assumes a dark, brownish, or chocolate color, and can no longer take up oxygen; the hæmoglobin is decomposed, and the injured blood-corpuscles accumulate in the spleen; the kidneys are brownish in color, and the tubules are choked with the broken-down materials of the red globules. The peculiar brownish color of the blood is found, by spectroscopic analysis, to be due to a substance identical with Hoppe-Seyler's methæmoglobin. These effects separate the chlorate, nitrate, and other compounds of potassa very distinctly from the compounds with vegetable acids, while the latter also differ distinctly from the former in the power to alkalinize the blood and urine.

A very considerable reduction of temperature is produced by large doses of the potash salts (Podcopaew, Guttmann, Traube). This effect, due especially to chlorate and nitrate of potassium, may be readily explained by the changes in the hæmoglobin, which impair its function as a carrier of oxygen. Ordinary doses do not affect temperature decidedly, probably because they do not have the power to change the properties of hæmoglobin. The alterations produced in the composition of the blood by the salts of potash necessarily affect the nutritive functions. The increased elimination of urea, the waste of the fatty constituents of the blood and of the tissues, the more rapid process of oxidation, results of the action of the potash salts, necessarily place these remedies among the list of those promoting destructive metamorphosis.

Drs. Ringer and Murrell find chloride of potassium to be a protoplasmic poison, and to this effect they refer its action on the brain and nervous system and on the heart. That potash is a poison to the heart has long been known. The experiments of Podcopaew, repeated subsequently by Guttmann, confirm this. Whether introduced directly into the circulation, by injection into the jugular vein or subcutaneously, the paralysis of the heart follows—more speedily, when the poison reaches the heart more directly. The arrest of the heart takes place in the diastole, and occurs after division of the pneumogastric, whence it must be concluded that the effect on the heart is not exerted through increase of the inhibition. As, when a large dose is suddenly precipitated on the heart, its movements are speedily arrested, and the muscle of the heart does not then respond to electrical excitation, the effects of the poison must be expended chiefly on the muscular tissue (Traube), but not wholly so, since, before the electro-contractility is entirely abolished, all motion may be arrested. The cardiac ganglia must therefore participate in the changes wrought by the poison. The effect of potash on the tension of the vessels—on the blood-pressure—is much influenced by the quantity and mode of administration. A large quantity by intra-venous injection quickly poisons the heart and lowers the pressure in the arterial system. On the other hand, small doses increase the tension (Hummel, Traube). As elimination takes place very rapidly, it is not surprising to find that the normal pressure is quickly restored. This difference in the result, due to the size of the dose, is largely responsible for the conflicting statements which have been put forward.

It has been ascertained by Ringer and Murrell, and by Guttmann, that the contractility of the muscles and the irritability of the motor nerves persist after complete paralysis induced by the potash salts.

The paralyzing action must, therefore, be exerted on the spinal cord. In fact, as Ringer and Murrell have shown, potash, being a protoplasmic poison, affects most injuriously the most highly specialized structures; hence the brain and spinal cord suffer earlier and more severely than do other tissues. We owe to Dr. Ringer some important discoveries as to the action of the alkalies on the frog's heart. As these observations are confirmed for the most part by clinical and experimental studies in man, they may be accepted as a close approximation to the actual facts. Potash, soda, and ammonia, in small quantity, increase the tonicity of the muscular walls of the heart, but in large quantity they manifest a paralyzing action, and this is especially true of potash, which is much more powerful than any of the alkalies. If the ordinary saline solution is made with river-water, when passed through the heart, the ventricular contractions are much prolonged; but, if a minute quantity of potash is added, the heart-beats assume the normal character. This result is probably due to the lime present in the river-water, for when a trace of a lime-salt is added to distilled water the same lengthening of the ventricular contraction takes place.

The elimination of the potash salts takes place by various channels, chiefly by the kidneys, but they also appear in the saliva, sweat, milk, and other secretions. The effect of these salts on the reaction of the urine and the differences in result due to the period of administration have been pointed out. The state of acidity of the stomach greatly affects the reactions of the urine produced by the carbonates of potassa (Ralfe). The salts of vegetable acids undergo decomposition in their passage through the system; they render the urine alkaline, and greatly increase the excretion of free carbonic acid (Parkes). The after-condition of the urine is that of increased acidity (Ralfe). The nitrate and chlorate of potassa are eliminated unchanged, and do not affect the reaction of the urine (Laborde). The notion entertained in some quarters that chlorate of potassa parts with its oxygen, is entirely erroneous. These salts increase the amount of urinary water, and, in common with the other members of the family, promote oxidation and the excretion of urea. While the acetate increases the discharge of urinary water, it actually lessens the quantity of solids excreted (Parkes). The production of saliva is much increased by the chlorate, which is freely eliminated by the salivary glands (Laborde). It is a very important fact, which we owe to Dr. Jacobi, of New York, that chlorate of potassa irritates the kidneys, and if continued a sufficient time sets up a chronic nephritis. Others have made similar observations, so that the popular use of this supposed harmless agent should be discouraged by the medical profession.

THERAPY OF THE POTASH SALTS.—Chlorate of potash is in almost universal use as a remedy for *catarrhal inflammation of the mouth and fauces*, for *acute tonsillitis*, *aphthous ulcerations of the mouth*, *stomatitis materna*, or nursing sore mouth, and *mercurial stomatitis*. As above stated, the domestic use of this remedy for sore mouth and sore throat has become an evil which should be discouraged. For ordinary purposes this remedy should not be employed. The utility of the chlorate is, however, so decided in the case of *stomatitis materna*, that all other considerations are merely secondary. In this malady large doses (fifteen grains to ℈j three or four times a day) are necessary, and a less amount will fail to effect a cure. In mercurial stomatitis, ulcerative tonsillitis, diphtheritic angina, etc., the following formula may be applied locally: ℞ Potassii chlorat., ʒj; acid. carbolic., ʒss; glycerini, ℥j; aquæ, ℥iij. M. Sig.: Lotion.

The potash salts are used with great advantage in many stomach-disorders. It is an undoubted chemical fact that an *excess of acid* is relieved by an alkali, but the result is not permanent, and the cause of the acidity is not removed. Small doses of an alkali, given with a bitter before meals, promote the flow of gastric juice, and are a serviceable combination in *atonic dyspepsia*. ℞ Inf. calumbæ, ℥iv; liq. potassæ, ʒss. M. Sig.: A dessert to a tablespoonful three times a day before meals. Administered after meals, the alkalies will relieve the acidity due to an excessive production of acid, or to the acid fermentation of the starch, sugar, and fat, in the food. An acid given before meals is the proper remedy for the excessive formation of the acid of the gastric juice. Alkalies render an important service in case of *indigestion of fats*. Not only do they prevent the formation of butyric acid, but they assist in the process of emulsionizing the fats and help their absorption. In diseases of the liver, and when from any cause the flow of bile into the intestine is prevented, alkalies assist in the digestion and absorption of fats. The *indigestion* of *obese* subjects, and of the *gouty* and *rheumatic*, is usually cured or alleviated by alkalies. The lithia salts are generally to be preferred in gouty and rheumatic subjects; but, generally speaking, the bicarbonate of potassium is the most useful of the alkali remedies in the above-mentioned maladies.

The salts of the alkalies, especially the citrates, tartrates, and carbonates of potassium, are useful in *inflammatory diseases* to lessen heat, and to promote excretion of the products of inflammation. When oxidation is deficient, as represented in an *excess of uric acid in the urine*, a coated tongue, hebetude of mind—the so-called "bilious state"—relief is afforded by the use of the alkalies and their laxative salts. The alkaline treatment of *acute rheumatism* is based on these principles. Although this plan of treatment may not be adapted to all cases, there can be no doubt of its utility in respect to a considerable proportion. It must be borne in mind, as Dr. Fuller, the most influential advocate of the method, informs us, that the alkaline treatment consists in a plan, made up in part of the use of bicarbonate of potassium, and in part of certain adjuvants, notably quinine. The main point in the treatment consists in the administration of remedies to induce an alkalinization of the system as quickly as possible, for when this is accomplished further joint and heart complications are not likely to occur. Fuller gives not less than an ounce and a half of bicarbonate of potassium, largely diluted with water, in the first twenty-four hours of the treatment. Sometimes this salt is given in effervescence with lemon-juice—in the proportion of two drachms to an ounce of lemon-juice—every three or four hours, or with citric-acid solution. If the bowels are torpid, one or more compound cathartic pills are prescribed in addition. As soon as the urine ceases to exhibit an acid reaction—usually at the expiration of twenty-four hours—the quantity of potassic carbonate is reduced one half. If the urine continues alkaline at the expiration of another period of twenty-four hours, the alkali is further reduced one half, and, on the fourth day, the same conditions continuing, the treatment ceases to be exclusively alkaline. Then the alkali is reduced to the amount necessary merely to keep the urine neutral—about a half-drachm of the bicarbonate three times a day, and quinine is given. In Dr. Fuller's words, three grains of quinine, dissolved in lemon-juice, is given three times a day in effervescence with half a drachm of bicarbonate of potash. In ninety-four cases of acute rheumatism thus treated, the average duration, from the beginning of treatment, was eleven days. This method is adapted to the treatment of the plethoric, obese, and muscular subjects, and in the experience of the author is not well suited to the pale, delicate, and anæmic rheumatic.

In *irritation of the urinary organs* due to an excess of acid, the combinations of potash with the vegetable acids possess a high degree of utility. The liquor potassæ is much prescribed under these circumstances, but, as it is very irritating to the stomach, the salts are preferable, and they are equally effective. The liquor potassii citratis is an excellent form for this purpose. There is no doubt that the long-continued use of alkalies (citrate, acetate, and carbonate of potassa) will effect the solution of *renal calculi*, which are usually composed of uric acid. As the urate of soda is often the nucleus of these formations, the soda alkalies should not be used. Small doses taken daily for lengthened periods are necessary. Such alkaline waters as the Vichy may be used if more agreeable to the patient, but the best results are obtained by the administration of the citrates and tartrates in a large quantity of distilled water. When the urine is acid in any of the forms of cystic irritation—from *stone*, *cystitis*, *stricture*, *enlarged prostate*, etc.—great relief is experienced from the use of alkalies, notably the liquor potassæ, the citrates, acetates, and carbonates of potassium. When the urine is alkaline in reaction, no benefit can be derived from the use of these remedies.

The bitartrate and the acetate of potassium are very certain *diuretics*, especially the first named. They are most effective when given largely diluted with water. A pleasant form in which to administer cream of tartar is the familiar "cream-of-tartar lemonade," made as follows: A sufficient quantity of the remedy is dissolved in hot water; when cold the clear solution is poured off; some lemons are cut up and put in it, and it is sweetened to the taste. This solution may be drunk *ad libitum*. Considerable stomach and intestinal distress often follows the free use of dilute solutions of these potash salts, in consequence of the abundant production of carbonic-acid gas. The potash salts are indicated as diuretics in *desquamative nephritis*, and in *general dropsy from valvular disease of the heart.* By determining a free urinary discharge in the one case, they assist in washing out the obstructing epithelium in the tubules; in the other, they relieve the tension of the venous system. Very little is accomplished by the use of alkaline diuretics in dropsical accumulations in the various cavities.

Sodium.—*Soda.*—Soda; *Natrium*, Ger.; *soude*, Fr. Dry, white, translucent pencils, or fused masses. Is soluble in water and in alcohol.

Liquor Sodæ.—Solution of soda. A colorless liquid, having an extremely acrid taste and a strong alkaline reaction. Dose, ♏ ij—♏ x.

Sodii Acetas.—Sodium acetate. In white or colorless crystals, which effloresce in dry air and are wholly soluble in water. Dose, gr. v—ʒ j.

Sodii Bicarbonas.—Sodium bicarbonate. A white, opaque powder, wholly soluble in water (1 in 12). Dose, gr. v—ʒ j.

Sodii Boras. — Sodium borate.; borax. In colorless crystals, which slightly effloresce in dry air and are wholly soluble in water. Dose, gr. ij—℈ j.

Sodii Carbonas Exsiccatus.—Dried sodium carbonate. A white, hygroscopic powder, having the same properties as the carbonate. Dose, gr. ij—gr. x.

Sodii Carbonas.—Sodium carbonate. Large, monoclinic crystals, rapidly efflorescing in dry air and falling into a white powder; alkaline taste and reaction. Soluble in 1·6 water at 60° Fahr., and nearly twice as soluble in hot water. Dose, gr. v—℈ j.

Sodii Nitras.—Sodium nitrate. Colorless, transparent, rhombohedral crystals, slightly deliquescent in damp air, having a cooling, slightly bitter taste, and a neutral reaction. Soluble in 1·3 water at 60° Fahr., and in 0·6 boiling water. Dose, ʒ j—℥ j.

Sodii Sulphas. — Sodium sulphate; Glauber's salts. Dose, ℥ ss —℥ j.

Sodii Chloras.—Sodium chlorate. Colorless, transparent crystals, or a crystalline powder, odorless, and having a cooling, saline taste. Soluble at 59° Fahr., in 1·1 part of water. Dose, gr. j—gr. xv.

Pulvis Effervescens Compositus.—Compound effervescing powder. Seidlitz powder. Each powder contains forty grains of bicarbonate of sodium and one hundred and twenty grains of tartrate of potassium and sodium (Rochelle salt) in one paper, and thirty-five grains of tartaric acid in the other paper.

ANTAGONISTS, INCOMPATIBLES, AND SYNERGISTS, are the same as those given under potassium.

PHYSIOLOGICAL ACTIONS OF THE SALTS OF SODIUM.—In respect to the merely alkaline properties, there is a close correspondence between potassium and sodium, but as regards other properties there is a wide divergence. The salts of soda are alkaline, and hence neutralize the acid of the gastric juice. They are readily diffusible. Like the potash salts, they increase the alkalinity of the blood, and under suitable conditions determine a change in the urine from acid to alkaline. The same results follow the administration during or between the intervals of digestion, as in the case of the potash salts. The alkalinity of the urine induced by soda salts ceases on the day following their administration, and the acidity is then increased. Soda has but little toxic action besides the local caustic effects. Caustic soda, like caustic potash, dissolves albumen, forms soaps with fats, and destroys the tissues widely and deeply. It is, however, less active than caustic potash. The composition of the blood does not appear to be altered by the salts of soda in any reasonable quantity. Laborde, in some comparative experiments between chlorate of potassa and chlorate of soda, finds that the latter, in treble the quantity of the former, has but a transient effect, depressing the temperature half a degree, and causing a slight salivation, but producing none of the paralytic symptoms which follow the administration of the potash salts. Guttmann had previously demonstrated the same facts, and Schönlein, in some studies with the carbonate, finds that even in large doses in frogs it rarely arrests the heart's movements, only slowing and lengthening the contractions. Chloride of sodium has, unquestionably, an important office in the economy. It forms the principal part of the soluble constituents of the ash of all animal substances. Albumen owes its solubility in part to the chloride of sodium; it dissolves pure casein, and impedes the coagulation of the fibrin of the blood. In one thousand parts of blood there are about four parts of this salt. It is very abundant in various normal secretions and pathological products. The gastric juice is very rich in chloride of sodium, and it probably is the source of the hydrochloric acid of the stomach (Lehmann). In the course of an inflammation, notably of pneumonia, the chloride of sodium of the system accumulates in the inflamed area, and disappears from the urine. Its return to the urine is in the nature of a critical phenomenon, and marks the subsidence of the inflammation. The importance of this salt in the animal economy is doubtless the cause of the universal taste; all in excess of the needs of the body is excreted, chiefly by the kidneys, and with such facility that no accumulation takes place. While a necessary amount is of high importance and excess is readily disposed of, it is probable that long and habitual indulgence in a considerable excess increases waste and lowers the vital forces.

Therapy of Sodium Salts.—One of the important salts of soda—the phosphate—has been considered under the head of phosphates. The soda salts are to be preferred in the alkaline treatment of stomach-diseases, but the potash salts when it is desired to promote oxidation in the system, or to alkalinize the urine. The urate of soda is insoluble. In case of *excess of acid* or *acid indigestion*, the use of soda after meals is very effective; but, while the immediate result is good, the after-effect is to increase the production of acid. Those who habitually take sodium bicarbonate for acid indigestion suffer severely from acidity. Taken before meals, or on an empty stomach, soda bicarbonate is useful in *atonic dyspepsia*, to increase the acid of the gastric juice. *Acute indigestion*, with vomiting, especially if the vomited matters are very acid, and there is burning at the epigastrium, may be quickly relieved by the effervescing powder. The *acid diarrhœa of children* is relieved by the bicarbonate of sodium. This salt may be utilized as an *emetic* in narcotic stupor when other emetics fail to act. The author has known this method to succeed in opium narcosis. A half to a drachm of bicarbonate in solution in water is swallowed or thrown into the stomach by the pump, and this is followed immediately by a similar quantity of tartaric acid. Brisk effervescence ensues, and the contents of the stomach are evacuated. In *intussusception*, the same expedient has been practiced with success. The solution of bicarbonate of sodium is thrown into the rectum, and is followed by the acid. Strong pressure must be made on the anus; the gas forces the bowel back through the ileo-cæcal valve and thus relieves. A stomach or bowel much softened by inflammation, or weakened by ulceration, is a contraindication of such an expedient.

In the treatment of the febrile state, and to lessen the acidity of the urine, the soda salts have been proposed as substitutes for the potash salts. The researches of Laborde, Guttmann, Podcopaew, and others, have shown that the former do not have the same powers as the latter, and that therefore the substitution can not be made successfully, although the difference is one of degree, rather than of kind.

Calcium.—*Calx.*—Lime; *Kalk*, Ger.; *chaux*, Fr.

Calcii Carbonas Præcipitatus.—Precipitated calcium carbonate. A fine, white powder, insoluble in water. Dose, gr. v—℈j.

Creta Præparata.—Prepared chalk. Dose, gr. v—℈j.

Liquor Calcis.—Lime-water. A saturated solution of lime in water.

Liquor Calcis Saccharatus.—Dose, ʒ ss—ʒ ij. (Unofficial.)

Mistura Cretæ.—Chalk mixture. Dose, ʒ j—℥ ss.

Syrupus Calcis.—Sirup of lime (lime 65 grm. to 1,000 c. c. of sirup and water). Dose, a teaspoonful or more.

Calcii Chloridum.—Calcium chloride. A colorless or whitish salt, sometimes translucent, very deliquescent. It is soluble in two parts of water, and also in alcohol. Dose, gr. v—℈j, and is preferably administered in milk. *This should not be confounded with chlorinated lime.* (Other salts of calcium are included under phosphates, hypophosphites, sulphides, and bromides.)

ANTAGONISTS AND INCOMPATIBLES, AND SYNERGISTS, the same as for potassium.

PHYSIOLOGICAL EFFECTS OF CALCIUM SALTS.—The important position of phosphate of lime in the organism has been already set forth under the appropriate head. It is only necessary to state in this connection that the lime salts are antacid, or alkaline, and as such they neutralize the acid of the gastric juice. They act locally as sedatives to the mucous membrane. Some of them have a local action merely, but the chloride is very diffusible, and the carbonate feebly so. Entering the blood in small quantity, they promote constructive metamorphosis; but the habitual use of large quantities hastens waste, or the retrograde metamorphosis of the tissues.

Administered in the ordinary way, however, the lime salts furnish materials needed by the organism in its growth. The carbonate of lime is taken up in limited quantity by the stomach-juices and re-enforces the same constituent in the blood. The chloride of calcium has a different office in the economy. It acts in a similar manner to the other chlorides, and has close relationship to the iodides. Clinical experience has shown that it possesses the ill-defined property known as *alterative*, removes certain toxic or morbific materials, and secures their excretion by the organs of elimination. The recent studies of the therapeutical actions of chloride of calcium have shown it to possess the remarkable property of an antagonist or antidote to the strumous constitution. No mere physiological investigation could have demonstrated this power; it is an empirical fact which we can not explain as yet by physiological methods. It has been shown, however, that under its use enlarged and cheesy lymphatics gradually resume their normal condition, tubercular deposits undergo a process of calcification, and ulcerating cavities discharge their contents and cicatrize. It can not, of course, be asserted that such surprising changes frequently occur, but, that they do sometimes take place, clinical experience has proved. From this point of view, then, chloride of calcium assumes a high degree of importance.

Therapy of the Calcium Salts.—No remedy is more frequently prescribed for *vomiting* than lime-water. It is given very often with milk, one half, one fourth, as may be, and the combination is effective in arresting vomiting due to acute troubles of the abdominal organs, and also useful in vomiting of cerebral and reflex origin. When the milk-cure is prescribed, lime-water is frequently added to enhance the digestibility of the milk. Carbonate of lime is a useful restorative and antacid in the acid indigestion, and in the diarrhœa of strumous children. By Dr. Warburton Begbie and by Dr. Coghill the chloride of calcium is strongly urged, as the most efficient remedy in the feeble digestion and disordered secretions of strumous children. The latter especially commends the use of the chloride in "children when the sleep becomes restless and troubled, the breath fetid, the tongue foul and coated, the tonsils enlarged, the evacuations irregular and offensive, with deficient secretion of bile." In the *colliquative diarrhœa* of the strumous, it is said to be curative, even when accompanied by enlargement of the mesenteric glands. According to the published observations of Begbie, Coghill, and Bell, we possess no agent so valuable in the *wasting diseases* of children of strumous origin, in *glandular enlargements*, etc. The testimony which has been lately published in respect to the curative power of chloride of calcium in *consumption* is certainly very striking.

Lithium.—Lithium.

Lithii Carbonas.—Lithium carbonate. A white powder, soluble in water (1 in 80, but more soluble in water saturated with carbon dioxide). Dose, gr. ij—gr. x.

Lithii Citras.—Lithium citrate. A white powder, deliquescent and soluble in twenty-five parts of water.

Lithii Citras Effervescens.—Effervescent lithium citrate. Composed of lithium carbonate, sodium bicarbonate, citric acid, and sugar. Dose, gr. v—ʒ ss.

Lithii Salicylas.—Lithium salicylate. A white powder, deliquescent on exposure to air, having a sweetish taste and a faintly acid reaction. It is freely soluble in water and in alcohol. Dose, gr. v—℈j.

Lithii Benzoas.—Lithium benzoate. A white powder, or small shining scales, permanent in the air, having a cooling, sweetish taste and a faintly acid reaction. Soluble in four parts of water and twelve parts of alcohol at 60° Fahr. Dose, gr. ij—gr. xv.

Antagonists and Incompatibles, and Synergists, are the same as for the other alkalies.

Physiological Actions of the Lithium Salts.—These remedies have strong alkaline and basic properties, and act on the organism of man in the same manner as the other members of the group. The compound of uric acid and lithium is readily soluble, differing in this respect from the urate of soda. It is said that the lithium salts alkalinize the urine more decidedly than even the potash salts.

THERAPY OF THE LITHIUM SALTS.—Garrod first introduced these remedies into medical practice for the treatment of *rheumatism*, and in his recent Lumleian lectures has demonstrated anew their exceptional value. Recently the compound of lithium and salicylic acid has been brought forward as a more effective remedy in the rheumatic diseases. The subacute and chronic cases, and the so-called *rheumatic gout*, are the forms of the disease in which the lithium salts are most serviceable. In the so-called *uric-acid diathesis*, in *renal calculi* composed of uric acid, and in *irritable bladder* from an excess of acid in the urine, the salts of lithium are useful. In the case of a renal calculus a very protracted use of a well-diluted solution is necessary. The carbonate of lithium, in carbonic-acid water and arseniate of soda dissolved in the same solution, has been highly extolled of late as a cure for diabetes. Dr. Martineau, the author of the plan, directs three grains of the lithium salt and $\frac{1}{10}$ grain of arseniate of soda to be dissolved by pressure in two pints of carbonic-acid water—quantity sufficient for three doses.

EXTERNAL APPLICATIONS OF THE ALKALIES.—A solution of common soda (impure bicarbonate) freely applied will often remove the *fetid sweat of the feet*, and the *odorous emanations which in some subjects escape from the axillary glands*. *Acne* occurring in persons with a greasy skin, and prominent and black sebaceous follicles, may sometimes be cured by alkaline lotions. ℞ Liq. potassæ, ʒ j; aquæ rosæ, ℥ iv. M. Sig.: Apply with a soft sponge twice a day. For *acute eczema* where there is much serous discharge, no applications are more efficient than solutions of the alkalies. ℞ Sodii carbonat., ʒ ss; aquæ, Oj. M. Sig.: The eruption to be covered with lint soaked in this solution. Stronger solutions can be used in old cases where the skin is much thickened. As alkalies, by absorbing the moisture and combining with the fat of the sebaceous matter, make the skin dry and harsh, it is useful to apply some form of oil after these alkaline applications, certainly after the stronger solutions. Mutton-suet is one of the best fats for this purpose.

In *prurigo* great relief is often obtained by an alkaline warm bath at bedtime. A solution of carbonate of potassium (ʒ iij—℥ iv) is recommended by Trousseau as a remedy for that obstinate affection—*pruritus vulvæ*. In *freckles*, *sunburn*, and *tan*, the following lotion is useful: ℞ Potassii carbonat., ʒ iij; sodii chloridi, ʒ ij; aquæ rosæ, ℥ viij; aquæ aurantii flor., ℥ ij. M. Sig.: Lotion.

To cleanse the scalp from dandruff (*pityriasis*), there is no more suitable application than a saturated solution of borate of soda. Powdered borax, mixed with sugar, is a domestic remedy for *aphthæ* of children; it is simply placed on the tongue. A saturated solution of borax in rose-water is a useful application to remove freckles, and to allay *pruritus vaginæ.*

For the cure of *corns* no application is so certain, prompt, and effective as liquor potassæ. It should be applied by means of a glass rod or pine-wood splinter to the summit of the corn, and the tissue softened by it scraped off. By successive applications the callosity is removed without pain or discomfort.

The so-called *ingrowing toe-nail* may be cured by the application to the irritable granulation, at the margin of the nail, of a solution of liquor potassæ (ʒ ij—℥ j). This solution is to be applied on cotton-wool, to the margin of the nail and to the ulcerated surface of the toe, until the nail is so far softened that it can be cut away without pain.

Unhealthy and *sloughing ulcers* may be destroyed by potassa fusa, and a healthy granulating surface be left. No more efficient escharotic can be used in *hospital gangrene.* As it penetrates deeply and widely, great care must be used to limit its application to the affected parts, and, as soon as the destruction is sufficient, to check the further extension of the caustic by washing with a dilute acid. Vienna paste—which is a mixture of equal parts of potassa and lime made into a paste with alcohol—is milder in operation, and therefore usually preferred. Caustic potash was formerly much employed to make *issues*, to open *abscesses* and *carbuncles*, but these applications are now quite obsolete. Induration of the *cervix uteri* and *chronic metritis* (hyperplasia of the connective tissue) are, it is said (Dr. Bennet), very effectively treated by application of caustic potassa and potassa cum calce; but such powerful means must be used with great caution, if at all. In *carcinoma*, when the disease is limited to the neck of the uterus and not too far advanced, caustic potassa may be used with advantage to destroy the diseased surface. This caustic is quite as efficient as any, probably, for the escharotic treatment of *cancer* when this method of treatment is employed.

A solution of the bichromate of potassium (gr. j—grs. x — ℥ iv) is an excellent local application in the treatment of the *catarrhal state of the nasal, buccal, or vaginal muçous membrane.* A saturated solution of this salt may be used as a caustic in place of chromic acid.

Carbonate of soda in saturated solution has been used lately with signal success in the treatment of *burns:* it allays the pain, checks suppuration, and favors healing (McClellan, Pring, etc.). Cloths dipped in a saturated solution, and covered with oiled silk, are kept on the part, the solution being renewed as rapidly as may be necessary. Dr. Duckworth reports that *toothache* may be quickly allayed by holding a solution of carbonate of soda in the mouth. Recently chlorate of potash has been used with success in the treatment of *epithelioma.* This practice was first suggested by Vidal in the treatment of *chancroïd*, and has since been successfully employed in the treatment of *obstinate ulcers*, epithelioma and *cancer* (Fereol, Leveque). In the simpler cases a saturated solution may be kept on, but in epithelioma and cancer the powdered chlorate is thickly applied over the sore. It is said to allay pain, remove fetor, and promote cicatrization when so applied. The internal use of the salt is recommended in conjunction with the topical application in cancer, epithelioma, and lupus.

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ALKALINE MINERAL SPRINGS.

1. North America.

Bladon Springs, Choctaw County, Alabama. A rolling, pine-woods region.

They contain carbonate of soda, carbonate of magnesia, carbonate of iron, carbonate of lime, sulphate of lime, carbonic-acid gas, sulphureted hydrogen (traces), and chlorine.

Congress Springs, Santa Clara County, California. In the Coast Range of mountains.

They contain carbonate of soda (15·418 grains to the pint?), carbonate of iron, carbonate of lime, chloride of sodium (14·894 grains to the pint), sulphate of soda, etc. They are highly charged with carbonic-acid gas.

California Seltzer Springs, Mendocino County, California.

They contain carbonate of soda, carbonate of magnesia, carbonate of lime, carbonate of iron (a trace), and chloride of sodium. They are also highly charged with carbonic-acid gas.

Perry Springs, Pike County, Illinois.

They contain carbonate of potassa, carbonate of magnesia, carbonate of iron, carbonate of lime, sulphate of soda, silicates of soda and potassa. Temperature of the water is from 48° to 50° Fahr.

St. Louis Spring, Gratiot County, Michigan.

This water contains carbonate of soda (7·684 grains to the pint), carbonate of magnesia, carbonate of iron, carbonate of lime (5·019 grains to a pint), sulphate of lime (6·925 grains to a pint), silicate of lime, and silica. This is one of the so-called "magnetic springs"—the magnetic property being due not to the water, but produced by the magnetization with terrestrial currents of the vertical iron tube through which the water flows. It is unfortunate that this part of the peninsula of Michigan, in which the numerous alkaline and saline springs abound, is very decidedly malarious.

Buffalo Lithia Spring, of Virginia. Contains well-defined traces of lithia, and is alkaline. This has been used with great advantage in gouty, rheumatic, and renal affections.

The Hot Springs, Bath County, Virginia, contain carbonates of lime and magnesia, sulphates of lime, magnesia, and soda, and chlorides of sodium, calcium, and magnesium. The temperature of the water ranges from 100° to 106° Fahr.

The Warm Springs, Bath County, Virginia, have a composition similar to the hot springs, but the temperature of the water is somewhat less. At these springs, extensive bathing-pools have been constructed. The best results have been obtained from the bathing, conjoined with the internal use of the water.

Berkeley Springs are also situated in Bath County. The waters are alkaline, of a constant temperature of 72° to 74° Fahr., and are employed by bath and internally.

Rockbridge Baths, Rockbridge County, Virginia. A mountainous region.

They contain magnesia and iron, with a small quantity of iodine. Temperature, 74° Fahr. Used chiefly in the form of baths.

Capon Springs, Hampshire County, West Virginia.

This water contains carbonate of soda, carbonate of magnesia, and traces of iodine and bromine. The temperature of the water is 66° Fahr. These springs are situated in a romantic mountain-region.

Besides the above, there are numerous weakly-alkaline waters, such as **Bethesda** and others of the **Waukesha** region of Wisconsin, in Southern Michigan, and in many parts of the United States. It is impossible to mention all of them, and especially to set forth the rather pretentious claims, or recognize the apocryphal cures, so persistently and profusely published by their owners. Unquestionably good results have been wrought by these waters. Besides the positive there are negative virtues in these numerous mineral springs : they take the place of the indiscriminate drug administration which is one of the evils of the time.

2. European.

Vichy, Central France.

There are several springs—*Grande Grille*, *Puits Carré*, *Hôpital*, *Celestins*, *De Mesdames*, and others. The waters contain carbonates of soda, of potassa, magnesia, and lime, sulphate of soda and chloride of sodium, phosphate of soda, arseniate of soda (a trace), carbonates of strontia and iron. The gas, which is abundant, is carbonic acid.

In the Vichy region there are numerous alkaline springs having similar properties. The temperature of the waters varies from 58° Fahr. (*Celestins*) to 178° Fahr. (*Chaudes Aigues*).

Mont Doré, valley of the Dordogne, France.

The waters are weak alkaline, and have a temperature from 90° to 104° Fahr. Their principal constituent is carbonate of soda. These springs lie among the volcanic mountains of Auvergne, at an elevation of 3,300 feet.

Vals, Ardèche, France.

The waters of these cold springs are remarkable for the quantity of carbonate of soda which they contain. They are abundantly charged with carbonic-acid gas.

Ems, on the Lahn, Germany.

These waters contain, according to the analysis of Fresenius, 14 to 15 parts of bicarbonate of soda, 7 parts of chloride of sodium, and 1·7 part each of bicarbonate of lime and bicarbonate of magnesia, with sulphates of soda and potash, and bicarbonates of iron, manganese, baryta, strontia, and alumina in small quantity, to the pint. The gas is carbonic acid, from 6 to 8 cubic inches to the pint.

Neuenahr, valley of the Ahr, between Bonn and Coblentz, Germany.

The waters of these springs have a composition similar to those of Ems, but have about half as much soda and very little salt.

Salzbrunn, upper Silesia, near Freiburg, Germany.

These waters are very rich in carbonate of soda.

Gleichenberg, near Gratz, Styria, Austria.

These springs are much more alkaline than Ems. The waters contain from 20 to 27 parts of carbonate of sodium, 19·5 of chloride of sodium, and 7·8 of carbonate of magnesium. The water is highly charged with carbonic-acid gas.

Therapeutical Uses of the Alkaline Mineral Waters.—As we have seen that alkalies taken before meals increase the production of acid gastric juice, the alkaline mineral waters are serviceable in *atonic dyspepsia.* They are especially useful in *catarrh of the duodenum and of the bile-ducts*, and in the *jaundice* dependent on this state of the mucous membrane. In *incipient cirrhosis*, in *congestion of the portal circulation*, and in *hæmorrhoids* due to the hepatic obstruction, they render important service. *Obesity*, which is frequently diminished by a course of alkalies, is better treated by alkaline waters, for at the springs these patients can be induced, more easily, to conform to the plan of exercise and diet necessary in these cases.

The alkaline springs have long had a deserved reputation for the cure of *gout and rheumatism.* With the internal use of the waters should be conjoined baths, douches, etc. *Gout* and *rheumatic affections of internal organs* are equally amenable to the same treatment.

These alkaline waters, long used, are especially serviceable in the so-called *lithic-acid diathesis.* There is little doubt that the continuous use of alkaline waters for a long period will cause the solution of *uric-acid renal calculi.* For this purpose those alkaline waters rich in potassa are preferable.

When *diabetes* is hepatic in origin, and occurring in obese subjects, the alkaline mineral waters are extremely useful. A suitable diet should be enjoined.

The following domestic mineral waters may be advised in the above states: Bladon Springs; the California Seltzer; Perry Springs; St. Louis springs; but especially Capon, Saratoga, Buffalo-Lithia, Bethesda, and other alkaline springs of Wisconsin.

Of the foreign, the most important are Vichy, which is imported at a moderate price, Mount Dore, Vals, Ems, Salzbrunn, and Gleichenberg.

The psychical influences of change of scene, associations, and climate, are largely concerned in the results of treatment with the waters of mineral springs.

SALINE MINERAL WATERS.

1. North American.

St. Catharine's Wells, St. Catharine's, Ontario, Canada.

These contain chloride of sodium (217 to 375 grains to the pint), chlorides of potassium, magnesium, calcium (108 to 127 grains to the pint), sulphate of lime, and iodide and bromide of magnesium. A concentrated water prepared by evaporation is used, properly diluted by patients at a distance for internal diseases, and at the wells, externally.

These waters are diluted with ordinary water to three fourths or seven eighths, before they are drunk. They are chiefly used as warm baths. The diseases in which they have been found most beneficial are *chronic gout, rheumatic gout, chronic rheumatism,* and *gouty* and *rheumatic diseases, strumous diseases, engorgement* of the *pelvic viscera, chronic metritis, uterine fibroids, hæmorrhoids,* etc.

Spring Lake Well, Ottawa County, Michigan.

The water of this spring contains chloride of sodium (50·691 grains to the pint), chloride of calcium (14·177 grains to the pint), chloride of magnesium, carbonates of soda, manganese, and iron, in small quantity, sulphate of soda (5·837 grains to the pint), bromide of magnesium, and a trace of lithia.

These waters are applicable to the treatment of *gout, rheumatism, strumous diseases,* etc. The waters are drunk and used as warm baths.

Saratoga Springs, Saratoga, New York.

In general terms, these waters contain chloride of sodium, the alkaline carbonates, and are highly charged with carbonic-acid gas. The springs are numerous, and differ somewhat in composition. I subjoin a tabular statement of the analyses of the different waters, which show their adaptation to various morbid states.

These waters are useful in *plethora of the abdominal viscera,* in *obesity,* in *habitual constipation* due to deficient secretion, in *plethora of the pelvic viscera, hæmorrhoids,* etc. The waters of the Pavilion and Geyser Springs, owing to the quantity of lithia which they contain, are especially serviceable in *chronic gout, chronic rheumatism, rheumatic gout,* and affections dependent on these diatheses. The Columbian, Pavilion, Eureka, and Excelsior, containing a considerable proportion of iron, are more especially adapted to cases of the above-mentioned disorders, in which anæmia exists, but they must be drunk with caution by the plethoric.

ONE PINT CONTAINS—	High Rock, 52° Fahr., Prof. C. F. Chandler.	Congress, 52° Fahr., Prof. C. F. Chandler.	Hathorn, Prof. C. F. Chandler.	Empire, Prof. C. F. Chandler.	Columbian, J. H. Steele, M. D.	Pavilion, Prof. C. F. Chandler.	United States, Prof. C. F. Chandler.	Seltzer, 50° Fahr., Prof. C. F. Chandler.
SOLIDS.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
Carbonate of soda	3·024	0·934	0·372	0·782	1·336	0·327	0·405	2·552
Carbonate of magnesia	4·069	9·019	13·072	3·182	3·461	5·650	5·399	2·988
Carbonate of iron	0·135	0·031	0·101	0·079	0·698	0·233	0·065	0·155
Carbonate of lime	11·443	12·449	14·815	9·520	8·500	10·432	8·084	7·804
Carbonate of lithia	0·154	0·374	....	0·163	....	0·744	0·380	0·071
Carbonate of strontia	trace.	trace.	trace.	trace.	....	trace.	0·001	trace.
Carbonate of baryta	0·050	0·095	0·178	0·008	....	0·090	0·094	trace.
Chloride of potassium	1·122	1·006	1·199	0·536	....	0·958	1·078	0·167
Chloride of sodium	48·766	50·055	63·746	63·328	33·875	57·480	17·734	16·786
Sulphate of potassa	0·201	0·111	trace.	0·346	....	0·254	....	0·069
Sulphate of soda	....	....	....	....	....	....	....	....
Sulphate of magnesia	....	....	....	....	....	....	....	....
Phosphate of soda	trace.	0·002	0·001	0·003	....	0·001	0·002	trace.
Phosphate of lime	....	....	....	....	....	....	....	....
Iodide of sodium	0·011	0·017	0·025	0·031	0·320	0·009	0·006	0·004
Bromide of sodium	0·091	1·069	0·192	0·033	....	0·123	0·106	0·079
Fluoride of calcium	trace.	trace.	trace.	trace.	....	trace.	trace.	trace.
Biborate of soda	trace.	trace.	....	trace.	....	trace.	trace.	trace.
Alumina	0·158	trace.	0·016	0·052	....	0·041	0·012	0·047
Silicate of potassa	....	....	....	....	....	....	....	....
Silicate of soda	....	....	....	....	....	....	....	....
Silica	0·283	0·105	0·157	0·182	0·256	0·394	0·398	0·320
Organic matter	trace.	trace.	trace.	trace.	....	trace.	trace	trace.
Total	69·502	75·267	93·874	78·215	47·946	76·745	33·764	31·042
GAS.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.
Carbonic acid	51 (1866.)	49 (1871.)	47	43 (1872.)	34	41	30	40

ONE PINT CONTAINS—	Geyser, 46° Fahr., Prof. C. F. Chandler.	Star, 52° Fahr., Prof. C. F. Chandler.	Red Spring, Prof. J. H. Appleton.	Eureka, R. L. Allen, M. D.	Excelsior, R. L. Allen, M. D.	Hamilton, R. L. Allen, M. D.	Crystal, 50° Fahr., Prof. C. F. Chandler.
SOLIDS.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
Carbonate of soda	6·175	1·097	1·107	0·625	1·875	4·281	1·212
Carbonate of magnesia	10·322	4·586	2·618	3·667	4·042	4·883	5·568
Carbonate of iron	0·089	0·110	....	0·375	0·402	0·578	0·185
Carbonate of lime	14·793	10·795	7·324	5·165	9·625	12·249	8·845
Carbonate of lithia	0·549	0·124	0·016	....	....	....	0·339
Carbonate of strontia	0·041	trace.	....	....	....	....	trace.
Carbonate of baryta	0·206	0·010	....	....	....	....	0·074
Chloride of potassium	3·079	1·212	0·686	....	....	....	1·040
Chloride of sodium	70·260	49·795	8·699	20·852	46·330	37·332	42·058
Sulphate of potassa	trace.	0·675	....	....	....	....	0·269
Sulphate of soda	....	....	....	....	0·165	....	....
Sulphate of magnesia	....	....	....	0·268	....	....	....
Phosphate of soda	trace.	trace.	trace.	....	....	....	0·001
Phosphate of lime	....	....	trace.	....	....	....	....
Iodide of sodium	0·031	0·015	....	0·583	0·529	0·449	0·008
Bromide of sodium	0·276	0·071	....	0·196	....	....	0·051
Fluoride of calcium	trace.	trace.	....	....	....	....	trace.
Biborate of soda	trace.	trace.	....	....	....	....	trace.
Alumina	trace.	trace.	[1]0·219	0·029	....	....	0·033
Silicate of potassa	....	....	....	....	0·875	....	....
Silicate of soda	....	....	....	....	0·500	....	....
Silica	0·013	0·160	0·339	0·067	....	[2]0·125	0·401
Organic matter	trace.	trace.	....	....	....	....	trace.
Total	105·834	68·650	21·008	31·827	64·343	59·897	60·089
GAS.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.	Cubic in.
Carbonic acid	57 (1870.)	50	....	29	31	40	39 (1870.)

[1] Alumina and sesquioxide of iron.

[2] Silica and alumina.

Ballston Spa, Ballston, Saratoga County, New York.

These waters are similar in composition to the waters of the Saratoga Springs, but they are richer in mineral constituents.

Bedford, Bedford County, Pennsylvania. These waters are purgative saline in character and composition, somewhat like those of Saratoga, but contain more iron.

There are probably in no part of the world more admirable mineral springs than those of Saratoga, and of Bath County, Virginia. Physicians of this country have not given them the attention they deserve, nor have their owners been sufficiently awake to their remarkable utility.

2. European.

Cheltenham, Gloucestershire, England.

These spas are saline aperient, iodureted saline, iodureted-magnesian saline, and the waters contain a good deal of carbonic acid. The season is from July to October. These waters are chiefly serviceable in *dyspepsia, hepatic affections,* and *constipation.* Some of the springs at Cheltenham contain iron, and the water of these is employed in *chlorosis* and *anæmia.*

Leamington, Warwickshire, England.

These waters contain chlorides of calcium and sodium, and sulphate of soda, with carbonic acid. They are much prescribed in *dyspepsia, acidity,* and *hepatic troubles, constipation,* etc.

Adelheidsquelle, Heilbrun, Bavaria. Altitude, 2,000′. Temperature of spring, 50° Fahr. Season, May to September.

This valuable water contains chloride of sodium, carbonate of sodium, iodide and bromide of sodium, etc.; carbonic acid, 13·18 cubic inches. It is highly prized in *strumous diseases, rheumatism, gout, affections of the skin,* and pelvic troubles of females (*chronic metritis, fibroids,* etc.).

Baden-Baden. Altitude, 616′. Mean annual temperature, 48° Fahr. Season, May to October.

According to Bunsen's analysis, these waters contain chloride of sodium, bicarbonate of lime, magnesia, and iron, sulphates of lime and potash, arseniate of iron (a trace), chloride of potassium, bromide of sodium (traces), etc.; carbonic-acid gas. The Meurquelle contains 2·3694 grains of chloride of lithium in 20 ounces.

Carlsbad, Bohemia. Altitude, 1,200′. Season, June to September.

These waters contain sulphate of soda, carbonate of soda, chloride of sodium, sulphate of potash, carbonate of lime, etc. Marktbrunnen contains, besides these ingredients, a small quantity of carbonates of lithia, strontia, and manganese, and iodide and bromide of sodium; the gas is carbonic acid.

The Carlsbad water is highly prized in *affections of the liver and portal system, uterine diseases, gout, rheumatism,* and *diabetes.*

Friedrichshall, Saxe-Meiningen, Germany. Bitter water.

According to Liebig, this water contains sulphate of soda, 46·51 grains; sulphate of magnesia, 39·55; chloride of sodium, 61·10; chloride of magnesium, 30·25; sulphates of potash, 1·52, and of lime, 10·34 grains. Carbonic-acid gas, 5·32 cubic inches.

This is *aperient*, and is *used in diseases of the stomach, liver, intestines, and kidneys.* It is imported in quart-bottles, and is much prescribed as a laxative in *habitual constipation*, in *hepatic troubles, plethora of pelvic organs*, etc.

Homburg, Central Germany. Altitude, 600′. Open all the year, but the season is from May to September. Temperature, 50° to 53° Fahr.

According to the analysis of Liebig and Hofmann, these waters contain chlorides of sodium (79 to 104 grains), potassium, magnesium, and calcium, carbonates of lime, magnesia and iron, and sulphates of soda and lime. Free carbonic acid, 48 cubic inches.

In therapeutical action they are laxative, and are prescribed in *habitual constipation, dyspepsia, abdominal and pelvic plethora, obesity, hypochondriasis, hysteria*, etc.

Kissingen, Bavaria. Altitude, 800′. Temperature of springs, 50° Fahr. The season is from May to September.

Liebig's analysis has shown that these waters contain chlorides of sodium (17·52 to 44·71 grains), potassium, lithium, and magnesium, sulphates of lime and magnesia, carbonates of lime and iron, bromide and iodide of sodium, etc. They are highly charged with carbonic acid.

Kissingen waters are laxative, and are used in *dyspepsia, hepatic obstructions, albuminuria, diabetes*, etc.

Kreutznach, Rhenish Prussia. Altitude, 285′. Season is from June to September.

This powerfully alterative water contains chloride of sodium (72 to 108 grains to the pint), chloride of calcium (13 to 22 grains to the pint), chlorides of magnesium, potassium and lithium, carbonate of lime and iron, bromide and iodide of magnesium.

The mother-liquor of Kreutznach contains 2,484 grains of solid matter in sixteen ounces.

These waters are extremely serviceable in *constitutional syphilis, strumous diseases, affections of the skin, rheumatism, gout, engorgement of the abdominal and pelvic organs, hepatic diseases*, etc.

Marienbad, Bohemia. Altitude, 1,900′. Season is from May to September.

The principal constituents of this water are sulphate of soda, bicarbonate of soda, chloride of sodium, bicarbonate of lime, bicarbonate of magnesia, and salts of lithia, strontia, iron, and manganese, in sma quantity; carbonic-acid gas.

Laxative, and used in *hepatic disorders, dyspepsia, habitual constipation, gravel, gout,* etc.

Reichenhall, Upper Bavaria. Altitude, 1,407'. Mean temperature of spring, 56° Fahr.; of summer, 64° Fahr.; of autumn, 54° Fahr. Season, July and August.

Used only for baths. Inhalations are practiced here on a large scale. "The compressed-air cure" is also a prominent feature of the curative methods. *Scrofula, phthisis,* and *affections of the throat,* are chiefly treated.

The waters are rich in chlorides of sodium and magnesia, and sulphates of soda and lime.

Seidlitz, Bohemia.

The chief constituents are sulphate of magnesia, sulphate of soda, carbonate of lime, sulphate of lime, sulphate of potash, and chloride of magnesium.

Saline purgative.

Selters, Nassau.

Kastner's analysis has shown that this water contains bicarbonate of soda, chloride of sodium, bicarbonates of lime and magnesia, iron and manganese, phosphates of lime, alumina and soda, bromide of sodium, etc. Highly charged with carbonic acid.

Laxative and alterative.

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AMMONIUM AND ITS PREPARATIONS.

PREPARATIONS.—*Ammonii Benzoas.*—Ammonium benzoate. Benzoic acid and ammonia. In minute, white, shining, thin, four-sided, laminar crystals; bitter, saline, and somewhat balsamic taste; soluble in water (1 in 5), and in 28 parts of alcohol. Dose, gr. v—gr. xv.

Ammonii Carbonas. — Ammonium carbonate. In white, translucent masses, with a pungent and ammoniacal odor, soluble in water (1 in 4). Dose, gr. v—gr. x.

Ammonii Chloridum.—Ammonium chloride. Sal ammoniac. In a snow-white, crystalline powder, soluble in three parts of cold water, and sparingly soluble in alcohol. Dose, gr. j—℈j.

Trochisci Ammonii Chloridi.—Troches of chloride of ammonium.

(Ammonium chloride, sugar, tragacanth, and sirup of tolu.) Each troche contains two grains of chloride of ammonium.

Ammonii Valerianas.—Ammonium valerianate. A white salt in quadrangular plates, having the odor of valerianic acid, and a sharp, sweetish taste, and is very soluble in water and in alcohol. Dose, gr. j—gr. v.

Ammonii Phosphas.—Ammonium phosphate. In colorless, transparent prisms, soluble in water (1 in 4), but insoluble in alcohol. Dose, gr. v—℈j.

Aqua Ammoniæ.—Water, or solution, of ammonia; contains 10 per cent by weight of gas. A transparent, colorless liquid, having a very pungent odor, and a strongly alkaline reaction. Dose, ♏ v—ʒ ss, well diluted with water.

Aqua Ammoniæ Fortior.—Stronger water of ammonia. An aqueous solution of ammonia containing 28 per cent by weight of the gas.

Liquor Ammonii Acetatis.—Solution of acetate of ammonium. Spirit of Minderer. Dose, ʒ j—℥ j.

Spiritus Ammoniæ.—Spirit of ammonia. A solution of ammoniacal gas in alcohol. Dose, ♏ x—ʒ j.

Spiritus Ammoniæ Aromaticus.—Aromatic spirit of ammonia. Solution of carbonate of ammonia and aqua ammoniæ, oils of lemon, pimento, and lavender, in alcohol and water. Dose, ʒ ss—ʒ ij.

Linimentum Ammoniæ.—Liniment of ammonia. Cotton-seed oil and aqua ammoniæ (30 parts to 70).

ANTAGONISTS AND INCOMPATIBLES.—The vegetable and mineral acids, acidulous salts, earthy salts, and lime-water, are incompatible with the carbonate. In addition to the acids, potash, soda and their carbonates, salts of lead, silver, and metallic sulphates, are incompatible with the solution of the acetate. The persalts of iron, acids, and liquor potassæ, are incompatible with the benzoate. Alkalies, alkaline earths and their carbonates, and lead and silver salts, are incompatible with the muriate. In the treatment of poisoning by ammonia or its carbonate, the vegetable acids should be used to neutralize the poison, and its irritant action on the mucous membrane should be limited as much as possible by the administration of oil and demulcents.

Therapeutically, ammonia is antagonized by veratrum viride, aconite, digitalis, cold, and other cardiac sedatives.

SYNERGISTS.—The action of ammonia is favored by heat, opium, iodine, by the antispasmodics, as valerian, asafœtida, etc., by the diffusible and aromatic stimulants, as alcohol, ether, etc. The therapeutical activity of the iodides and bromides is promoted by combination with carbonate of ammonia.

PHYSIOLOGICAL ACTION.—Ammoniacal gas, brought in contact with a mucous surface, irritates it; applied to the eye, it reddens the conjunctiva, and causes lachrymation; applied to the nares, it reddens the mucous membrane, produces a sense of heat and burning, and increases the secretion of mucus. Inhaled, an overpowering sense of suffocation is experienced, and the glottis spasmodically closes. Prolonged contact with the air-passages excites violent inflammation. When solution of ammonia is swallowed, an active and destructive inflammation of the mucous membrane is set up; the lips, tongue, soft palate, and tonsils are swollen, red, and glazed; the epiglottis, and especially the arytæno-epiglottidean folds, become œdematous, and sudden death may ensue from œdema of the glottis. Inflammation of the œsophagus, and of a limited portion of the stomach, will also follow the introduction of any portion of the irritant. Narrowing (stenosis) of the pyloric orifice has been noted, in one case, as an after-result of the inflammation set up in this part. In the stomach, ammonia and its carbonate must quickly combine with the acid, and probably enter the blood in such combination. Increased action of the heart is produced by its administration by the stomach, but much more decidedly when it is thrown directly into a vein. After the intra-venous injection of ammonia, the blood-pressure at first rises, then falls below the normal. Resulting, doubtless, from the increased action of the heart, and the more rapid circulation of the blood, a subjective sensation of warmth throughout the body is experienced, the face becomes flushed, the eyes are more brilliant, and the mental operations increase in activity. Little is known of the behavior of ammonia in the blood, which in the normal state contains this gas. Although it is now known that the coagulation of the blood is not caused by the escape of ammonia, as supposed at one time by Richardson, yet ammonia helps to maintain the fluidity of the blood, as its presence, in sufficient quantity, certainly serves to hold the fibrin in solution.

The long-continued use of ammonia impairs digestion, by neutralizing the gastric juice. Increased waste of tissue is also one result of its administration, manifested by pallor, emaciation, and feebleness. When introduced into the blood in sufficient quantity, it damages the structure of the red blood-globules, and in this way also it affects the nutrition of the body, besides the action which it has, in common with the other alkalies, of increasing the rate of waste or retrograde metamorphosis.

The summary of the physiological actions of ammonia, above given, pretty fairly represents the movement of these agents as a group; but individual differences undoubtedly exist, which will be pointed out when the therapy is considered.

THERAPY.—Ammonia and its carbonate are sometimes used to diminish *acidity* of the stomach-juices. *Obstinate vomiting*, after irritating substances are removed, and when the vomited matters are acid, may be relieved by the use of the carbonate, or better, by an excess of carbonate in solution of the acetate. The *acidity, gaseous eructations*, and *abdominal distention*, which accompany attacks of hysteria in some females, may be quickly removed by the aromatic spirit of ammonia. *Nervous headache*, especially when it is present with the last-mentioned group of symptoms, is speedily relieved by the aromatic spirits and the carbonate ; but true *migraine*, although these preparations of ammonia may palliate it, is generally more certainly relieved by the bromides. Raspail's *eau sédatif* often gives great comfort in headache, when locally applied.

In *gastric* and *intestinal catarrh*, chloride of ammonium is held in high repute by our German *confrères*. It is certainly highly serviceable in some *hepatic disorders*—for example, in *catarrh of the bile-ducts* and in the *jaundice* arising from this cause. In the first stage of *cirrhosis*, before contraction and induration have occurred, it is also useful. The nauseous saline taste of the sal-ammoniac is best covered by fluid extract of taraxacum or extract of liquorice. The fluid extract of taraxacum is to be preferred as the vehicle in hepatic disorders, because this drug has reputed virtues in these cases. When there is *deficiency of secretion of the intestinal juices, constipation*, and a *coated tongue*, with *scanty and high-colored urine* (so-called bilious state), sal-ammoniac is one of the remedies which may be used with success. That this drug has a selective action on the liver seems probable from the fact that it increases the excretion of urea by the kidneys.

To *stimulate the action of the heart* when it flags, the ammonia preparations have an undoubted effect ; hence in adynamic states they are frequently used. When employed for this purpose, small doses frequently repeated (every half-hour or hour) are necessary, owing to the fact that ammonia is quickly eliminated. It is a most common practice to inhale ammonia to prevent that depression of the heart's action called *fainting*. It should not be forgotten that ammonia, incautiously inhaled, may give rise to inflammation of the fauces and glottis. The preparations of ammonia (spirits, carbonate, water of) possess a high degree of utility when *thrombosis* is actually existent, but especially when threatened, as in the *puerperal state*, after *free hæmorrhage*, when the circulation is languid from weak heart, a state of hyperinosis being present. It is perfectly safe and legitimate under these circumstances to practice the intra-venous injection of aqua ammoniæ, ʒ j—ʒ ij, diluted with an equal measure of water. This practice seems more particularly advisable when sudden thrombosis of a large venous trunk ensues—as, for example, in the pulmonary artery, after uterine hæmorrhage.

As ammonia has the property to dissolve fibrin, and as its presence in the blood contributes to maintain the solubility of its solid and morphotic constituents, the intravenous injection, if timely, may succeed in redissolving thrombi, but, as direct contact is necessary other mode of administration can be substituted. When thrombosis occurs after *post-partum* hæmorrhage, the promptest action is necessary; hence the obstetrician should go provided with the materials required.

In sudden paralysis of the heart from *poisonous gases, snake-bites, chloroform narcosis*, etc., the intravenous injection of ammonia is a promising expedient. A remarkable example of the power and utility of the practice was published by Dr. J. T. Eskridge, of Philadelphia, in 1883. As the author had personal knowledge of all the circumstances, he can testify to the truth of the narrative. In a case of sudden and most profound depression of the powers of life caused by the gases of a privy-vault, and which must have proved fatal if relief had not been given, Dr. Eskridge practiced twelve intravenous injections of what was supposed to be diluted *aqua ammoniæ*, but on subsequent examination proved to be *aqua ammoniæ fortior.* The whole amount thrown into the circulation was 140 minims, and a vein in front of the elbow was the point of entrance of the fluid, the usual precautions being taken to prevent accident. No ill result occurring, and the patient saved from inevitable death, make this case in the highest degree instructive. Although Brunton and Fayrer have pronounced adversely to the method when used in the bites of the venomous snakes of India, it appears to have been successful in the hands of its discoverer, Halford, of Australia, against those of that part of the world. It appears to me to be probable, in view of the experience of Eskridge, that the failures above referred to were a consequence of insufficient quantity of the ammonia. In failure of the heart during *chloroform narcosis*, the intravenous injection of ammonia has not succeeded. The reason for this is to be found in the condition of the heart. As a rule, the heart stops suddenly and completely, and hence, before the injection can be practiced, the cardiac ganglia have ceased entirely to functionate. Other medicinal agents, as hydrocyanic acid, nicotine, etc., in toxic quantity paralyzing the heart, cause a complex of conditions for the relief of which the ammonia injections may be employed.

The mode of procedure consists in completely filling the syringe with the solution so that no air is contained in the instrument, or, if the quantity is insufficient to occupy the whole space, to exclude the air by a movement of the piston; then any vein conveniently situated for the purpose, and large enough, is selected, steadied between two fingers of the left hand, with the right hand the needle is plunged into the interior of the vein, and the solution is slowly forced into the blood-current. When the needle is withdrawn, light pressure with the finger suffices to prevent the escape of any blood. The repetition of the injection will depend on the effects, and the limit to the amount used will be determined by the state of the heart.

Ammonia is a *physiological antagonist to hydrocyanic acid*, and is used in poisoning by this agent; it counterbalances the depression, and maintains the heart's action, until the effects of the poison are spent.

Carbonate of ammonia is one of the remedies occasionally successful in the treatment of *delirium tremens*. It is indicated, and proves most serviceable, when there is present anæmia of the brain, and the heart's action is feeble. Half-ounce doses of solution of ammonia acetate are said to remove the effects of alcoholic intoxication. The *valerianate of ammonia* and the aromatic spirits of ammonia abort or prevent paroxysms of *hysteria*. *Nervous headache* and also *migraine* may sometimes be cured by the various preparations of ammonia; but of these the muriate is exceptionally serviceable. Indeed, Dr. Anstie affirms that this agent, if given early enough, seldom fails to cut short an attack of *migraine*. It should be administered in doses of from ten to twenty grains. In *myalgia*, or muscular neuralgia, it is equally effective, according to the same authority: ℞ Ammonii choridi, ℥ ss; ext. cimicifugæ fluidi, ℥ j; glycerini, ℥ ij; syrupi tolu, aquæ laurocerasi, āā ℥ j. M. Sig.: A teaspoonful three or four times a day. In other neuralgiæ the muriate of ammonia is occasionally useful, but by no means so curative as in *migraine* and myalgia.

The preparations of ammonia are classed with the *stimulant expectorants*. It is an interesting fact, in this connection, that they are eliminated largely by the lungs; and it is probable, indeed, that in thus escaping they stimulate secretion and liquefy the products of inflammation. In *bronchorrhœa* and *chronic bronchitis*, muriate of ammonia renders important service. It is given in extemporaneous prescriptions with extract of liquorice, and may be combined with other stimulating expectorants when no incompatibility exists: ℞ Ext. eucalypt., fl ℥ j; ammonii chloridi, ʒ ij; ext. glycyrrhizæ, ʒ ij; glycerini, ℥ iij. M. Sig.: A teaspoonful four or six times a day. When great depression exists in *pneumonia*, carbonate of ammonia is given with advantage. It should be remembered that to stimulate the heart merely, when an obstacle exists in the pulmonary circulation, is of doubtful utility; but ammonia liquefies the exudation, and thus removes obstruction of the air-sacs; hence it becomes a remedy of great value during this stage up to the period of crisis. When there is much adynamia in these various pulmonary inflammations, the carbonate of ammonia is frequently prescribed in infusion of senega, a stimulating expectorant.

Extraordinary success has been claimed for carbonate of ammonia in *variola*, *scarlatina*, *rubeola*, and *erysipelas*. A convenient mode of administration is to dissolve the carbonate in the solution of the acetate. The indications for the use of the carbonate are, feeble circulation, cyanosis, delirium. As these are self-limited diseases, the mild cases do quite as well without drugs.

Carbonate and acetate of ammonia are much prescribed in *continued fevers*—the latter as a so-called febrifuge; the former when decided adynamia ensues. In *typhoid* the diarrhœa may be increased by the solution of the acetate. As in typhus and typhoid the ammonia in the blood is increased above the normal, it has seemed to the author improper practice to administer ammonia as a remedy in these diseases, and his observations have convinced him that it has no good effects which can not be better procured by other means.

The chloride of ammonium is said to be an excellent *emmenagogue* in from ten to twenty grains.

Vapor of Ammonium Chloride.—An apparatus for generating fumes of ammonium chloride has long been in use for the relief of affections of the upper nasal passages. I am indebted to my friend Dr. W. M. Mew, of the Army Medical Museum, for the following suggestions as to the mode of preparing the vapor for inhalation in suitable cases:

"Of course, putting two open vessels, containing respectively HCl and NH_3, would result in giving off fumes, but the supply of almost imponderable smoke would be so small as to be wholly inadequate for therapeutical purposes. My plan is therefore to set free a large amount of HCl by decomposing $NaCl$ with strong H_2SO_4, yielding gaseous HCl and leaving a residue of Na_2SO_4 in the containing vessel, usually a soup-plate. A saucer (used to distinguish it from the acid container to avoid mistakes) containing stronger ammonia is placed by the side of the soup-plate, and at once the room is filled with the smoke. . . . Generally I direct that three or four ounces of the acid are to be poured into the soup-plate, and about the same quantity of the ammonia into the saucer, and without loss of time about a tablespoonful of table-salt is sprinkled on the acid. Decomposition takes place at once. Some precautions are necessary here: should there be an excess of HCl liberated (which would irritate the nasal passages), more NH_3 should be used. An excess of NH_3 would be in evidence by its odor, requiring more salt or more acid. The neutral or properly balanced salt does not irritate the most delicate membrane. . . . By the occasional addition of a little salt, or acid, or ammonia, this can be kept up for hours—from four to six hours."

The air of the apartment charged with the fumes, the inhalation can go on from four to six hours or longer.

BARIUM AND ITS PREPARATIONS.

Barii Chloridum.—Chloride of barium. Occurs in colorless, translucent tablets. It is soluble in diluted alcohol, and freely and entirely soluble in water. Dose, gr. $\frac{1}{10}$—gr. ss.

Barii Dioxidum.—Barium dioxide. A heavy, grayish-white or pale yellowish-white, amorphous, coarse powder. Almost insoluble in cold water. Hydrochloric and phosphoric acids decompose it, forming corresponding barium salts with hydrogen dioxide in solution.

Antagonists and Incompatibles. — Sulphates, phosphates, and carbonates, and most of the salts of organic acids, are incompatible with it. Nitrate of silver decomposes it. The sulphates are ready antidotes, as sulphates of magnesium or sodium.

Synergists.—The alkalies, and metallic salts from the therapeutical stand-point, increase its action on the retrograde metamorphosis. Ergot and digitalis favor its influence over the sympathetic system.

Physiological Actions.—The soluble salts of barium have a disagreeable, bitter, and astringent taste. In a full medicinal dose irritation of the stomach is caused, and a sense of heat and burning is developed at the epigastrium. In one case (Ferguson) symptoms of poisoning came on in a week, produced by one twelfth of a grain of chloride of barium, administered three times a day, the whole amount taken being two and a half grains. The symptoms were extreme exhaustion and nervousness. An idiosyncrasy must have existed here, as so small an amount would not, under ordinary circumstances, have produced such decided effects. The usual symptoms in cases of poisoning are intense anguish, free salivation, great thirst, loss of voice, violent vomiting and purging, dilated pupils, frequent micturition, respiration slow and labored, pulse slow, increasing weakness, and finally complete paralysis of the extremities. The intelligence is preserved until near the end, when convulsions and coma come on. The *post-mortem* rigidity is very decided. There are present very considerable bronchial effusion and hyperæmia of the lungs, the heart is distended with black blood, and the brain is engorged. The stomach presents the usual appearances; there is intense hyperæmia, and sometimes perforation of this organ. The quantity necessary to cause death varies greatly—two and a half grains have brought on serious symptoms, and half a teacupful of the carbonate has been recovered from. One drachm of the chloride has caused death in seventeen hours, and one ounce of the same salt in one hour (Woodman and Tidy).

The effects on animals have been studied by Onsum, Cyon, Böhm, and myself (unpublished). Onsum held that the symptoms produced by the soluble salts of barium, when injected into the blood, were due to the formation of the insoluble sulphate. Cyon criticises this view, and shows that it is incorrect. The most elaborate, as it is the most recent, account of the physiological effects of the barium salts is that of Böhm. The statement to follow is based on this paper chiefly, and on the author's personal researches. In frogs, after injection of the chloride into the lymph-sac, extension and rigidity of the voluntary muscles ensued, followed by relaxation and paresis. The belly becomes distended and the intestines are thrown into active movements; the mouth is held wide open and a watery fluid continually escapes, while from the skin a mucus-like secretion exudes. When given to warm-blooded animals by the stomach, profuse secretion takes place, active peristalsis of the bowels and copious alvine discharges, and free urination follow, but not until about a half-hour after the ingestion of the poison. If thrown into the veins the same symptoms arise immediately: in either case the tonic and clonic convulsions followed by paralysis occur; the pupils dilate; the heart is slowed, but its contraction is more energetic; the tension increases enormously in the arterial system after a preliminary fall, and finally insensibility and coma terminate the action. Very large doses, suddenly precipitated on the heart by injection into the jugular vein, will induce paralysis both of the heart and lungs. With the peripheral paralysis labored breathing ensues, due to paresis of the respiratory muscles, and death is caused rather by this than by cessation of the heart's action, when the poison is introduced subcutaneously. The paralysis in animals begins in the hind extremities. This paralysis is preceded by fibrillary trembling and clonic spasms mixed with tonic rigidity. The muscular contractility is entirely abolished when the paralysis is complete. On the nervous system of organic life barium chloride acts as a stimulant. The strong cardiac contractions, the dilated pupil, the energetic peristalsis of the bowels, the closure of the lumen of the intestines and also of the bladder, and the almost complete approximation of the peripheral vessel-walls, are the proofs of this excitation.

THERAPY.—Influenced by the observations of Böhm, Dr. Flint, of Leeds, England, has employed the chloride of barium successfully in the treatment of *aneurism*. The case was one of abdominal aneurism, in a woman of sixty-five. Tufnell's treatment had been carried out faithfully for five months without success, and iodide of potassium, for some unexplained reason, could not be taken. Chloride of barium was, after careful consideration, selected, and one fifth of a grain three times a day was administered three or four weeks, when it was increased to two fifths. The curative effect was very manifest, for after nearly five months of continued use of the same remedy the tumor was so reduced that it could be scarcely felt. Several similar cases have since been reported. Chloride of barium has proved very useful in *hæmorrhage*, in *acute congestion of organs*, in *atony of the intestines* with deficient secretions, in *atony of the bladder*, in weakness of the heart with low arterial tension, in effecting removal of inflammatory exudates, etc. In the last-mentioned condition, especially, has the author used chloride of barium with excellent effect.

VEGETABLE ACIDS.

Acidum Aceticum.—Acetic acid. Liquid ; specific gravity 1·048. Colorless, having a pungent and characteristic odor. Of this acid one hundred grains neutralize sixty grains of bicarbonate of potassium.

Acidum Aceticum Dilutum.—Diluted acetic acid. 100 grm. of acetic acid, and distilled water, 500 grm.

Acidum Aceticum Glaciale.—Glacial acetic acid. Nearly or quite absolute acetic acid. At or below 59° F., a crystalline solid.

Acidum Citricum.—Citric acid. In colorless crystals, freely soluble in water and soluble in alcohol. One hundred grains of citric acid neutralize one hundred and fifty grains of carbonate of potassium.

Syrupus Acidi Citrici.—Citric acid, eight parts ; water, eight parts ; spirit of lemon, four parts, and nine hundred and eighty parts of sirup.

Acidum Tartaricum.—Tartaric acid. In colorless crystals, wholly or almost wholly dissipated by heat, and readily soluble in water. One hundred grains of tartaric acid saturate one hundred and thirty-three and a half grains of bicarbonate of potassium.

Antagonists and Incompatibles.—The alkalies are the chemical antagonists.

Synergists.—The alkalies and agents promoting waste favor the therapeutical actions of the vegetable acids.

Physiological Actions.—The vegetable acids, undiluted, have a sharp, pungent, and rather acrid taste ; but, when considerably diluted, they are rather agreeable and refreshing. They have the property to diminish the sense of thirst, to abate heat and the restlessness of fever. In large quantity, they possess considerable caustic power, producing gastro-enteritis and its results.

There can be no doubt that these acids obey the chemical laws of combination, and unite with alkalies to form salts, in which form they enter the blood. The most important question connected with the physiological action of these agents is, the disposition of them in the blood. The most recent and elaborate examination of this point is the "Memoir" of Friedrich Walter. This research appears to have determined that these acids do not have the power to neutralize the alkalinity of the blood, as has heretofore been supposed. That they are in part destroyed in the organism by the ozonizing action of the blood, seems undoubted. Carbonic acid is one of the products, and the presence of this, we may assume, accounts for the increased acidity of the blood and of the urine which follows the administration of these agents.

They are eliminated by the intestinal canal, and chiefly by the kidneys. They increase secretion from the intestinal mucous membrane, and are apt to produce tormina, flatulence, and diarrhœa. It is probable that these intestinal effects are in part due to the fact that the salts, formed by combination of the acids in the canal, escape absorption and act locally as they descend.

These acids, or the salts formed by their combination, have a decided power to promote diuresis. In this result all of the urinary constituents are included; but it is chiefly the water which is increased. To these general statements some exceptions must be made. Thus, citric and acetic acids are entirely destroyed in their passage through the organism; benzoic acid is converted into hippuric; and tartaric, citric, and malic are converted into carbonic after combination with an alkali only. Furthermore, benzoic acid does not increase any of the urinary constituents.

Ultimately, wasting and emaciation, a watery condition of the blood, and a scorbutic state (Bence Jones), are the results of the action of these agents.

Therapy.—Acetic acid applied to the skin has some superficial caustic property. This is made use of to cure *small warts* and *vegetations of the skin.* It is applied with a pine stick. *Parasitic affections* of the skin are similarly treated, as, for example, *pityriasis.*

Internally the acids, chiefly citric, in the form of lemonade, are used as a refreshing drink in *fevers.* They allay restlessness by relieving thirst, and they also act upon the skin and kidneys. Lime-juice is the most important *antiscorbutic,* and constitutes part of the equipment of every vessel on long voyages. It should not be forgotten that the use of lemon-juice may cause precipitation of uric acid, and thus favor the formation of calculi, as has been pointed out by Bence Jones.

Lemon-juice was at one time the fashion in the treatment of *acute rheumatism;* but more efficient remedies have taken its place.

Acids are serviceable in various disorders of the digestive tract; given before meals, they check the formation of acid, and thus relieve *acidity.* An acid and dry wine—as, for example, a Rhenish wine—may sometimes serve a useful purpose. The juice of a lemon may be taken before meals with the same object. But it is true that the mineral acids are to be preferred for this purpose. Very injurious effects are produced by the long-continued use of lemon-juice in such cases. It is sometimes taken by young ladies to keep down the formation of fat; but it accomplishes this object by impairing digestion.

Authorities referred to:

Jones, Dr. H. Bence. *Lectures on Materia Medica. The Medical Times and Gazette,* October, 1854, p. 408.

Parkes, Dr. E. A. *On the Urine,* 1860, p. 146.

Walter, Friedrich. *Untersuchungen über die Wirkung der Säuren auf den thierischen Organismus. Archiv f. exper. Pathol. u. Phar.,* 1877, p. 148.

Acidum Oxalicum.—Oxalic acid.

Properties.—Oxalic acid occurs in flat oblique rhombic prisms, transparent, colorless, soluble in about eight parts of cold water, and in nearly all proportions in boiling water. It is strongly acid to the taste and in reaction, and combines with bases to form salts. Dose, gr. ⅛ to gr. ss.

Actions and Uses.—In sufficient doses it is an irritant poison, causing nausea, vomiting, and gastro-intestinal inflammation. The matters brought up assume a brownish hue and presently become bloody. Intense burning pain occurs, and profound depression comes on, terminating in collapse. Very large doses may be rejected by vomiting, and no further symptoms occur. In ordinary toxic quantity, oxalic, besides the local gastro-intestinal inflammation, affects the action of the heart, which becomes feeble and intermittent, and death ensues by cardiac failure, with stupor, coma, and insensibility, and sometimes convulsions. In some rather exceptional cases the gastro-intestinal symptoms are comparatively mild, and the force of the poison is expended on the nervous system. In such examples there ensue stupor, general muscular paralysis, and finally complete loss of consciousness; or, with but little gastro-intestinal disturbance, the patient passes at once into coma and complete muscular resolution. It does not act on the peripheral nerves.

In experiments on animals, it has been ascertained that repeated administration in moderate doses sets up oxaluria, and subsequently albuminuria with tube casts (Kobert). The same observer found that the exhibition of non-toxic quantities caused a form of glycosuria to appear. Whether this is due to the local action of the poison at the point of excretion, or to an interference with the amylolytic transformations of the primary assimilation, remains undetermined. It is certainly true the oxalates form concretions that line the tubules of the kidneys in rabbits, and must therefore exercise some irritant action along the points of contact. In what way soever determined, it is an interesting fact that oxalic acid causes albuminuria and glycosuria when administered to animals, and the presence of sugar in the urine has been ascertained in some cases of poisoning in man.

Oxalic acid has powerful germicide properties.

Poisoning by this agent is to be treated on the same general principles as the mineral acids.

Therapeutically, it is indicated in the treatment of *albuminuria* with tube casts on the principle of antagonism. In the same way it may be applied to the treatment of *diabetes*, since it causes glycosuria in man. It is said, also, to be an efficient remedy in *amenorrhœa*. It is indicated in cases requiring an active stimulant to the uterus and ovaries.

SULPHUROUS ACID AND THE SULPHITES.

Acidum Sulphurosum.—Sulphurous acid. A colorless liquid, having the odor of burning sulphur, and a sulphurous, sour, and somewhat astringent taste. Dose, ♏ v—ʒ j.

Sodii Hyposulphis. —Sodium hyposulphite. In large, colorless, transparent crystals, having a bitter, slightly alkaline, and sulphurous taste. It is soluble in one and a half part of water at 60°, and insoluble in alcohol. Dose, gr. v—℈j.

Sodii Sulphis. —Sodium sulphite. In white, efflorescent, prismatic crystals, soluble in four parts of cold and in less than one part of boiling water. It has a sulphurous taste, and a feeble alkaline reaction. Dose, gr. v—℈j.

Sodii Bisulphis. —Sodium bisulphite. Opaque, prismatic crystals, or a crystalline or granular powder, slowly oxidized and losing sulphurous acid on exposure to air, having a faint sulphurous odor and taste, and an acid reaction; soluble in four parts of water at 60° Fahr., and in two parts of boiling water. Dose, gr. iij—gr. x.

Magnesii Sulphis.—Magnesium sulphite. (Unofficial.) A white, crystalline powder; is insoluble in alcohol, but soluble in twenty parts of water at 59° F. Dose, gr. v—℈j.

Potassii Sulphis.—Potassium sulphite. In white, opaque fragments or powder, very soluble in water. It has a saline and sulphurous taste. Dose, gr. iij—gr. x.

Antagonists and Incompatibles.—The mineral acids—including sulphuric—decompose the sulphites and hyposulphites. All oxidizing substances are incompatible. These preparations have a great affinity for oxygen, and the sulphites readily become sulphates.

Synergists.—All remedial agents which arrest fermentative processes promote the therapeutical activity of sulphurous acid and the sulphites.

Physiological Actions.—Sulphurous acid is a disinfectant and deodorizer. It attacks organic matter with energy, by virtue of its affinity for oxygen. It is very destructive to the lower forms of life, bacteria, fungi, etc. Sulphurous-acid gas inspired produces great irritation of the glottis, and an intensely suffocative feeling. In sufficient quantity it produces violent inflammation of the air-passages. As by combination with oxygen sulphuric acid is formed, the destructive effect ascribed to sulphurous acid is in reality chiefly due to sulphuric.

The sulphites exposed to the air rapidly absorb oxygen, and pass to the state of sulphates. The hyposulphites are more constant than the sulphites. In the stomach, by the acid of the gastric juice, these salts are in part decomposed and sulphurous acid is given off; in part they are converted into sulphates. They are undoubtedly absorbed as sulphates, and are eliminated partly by the intestinal canal, but chiefly by the kidneys, as sulphates. The author demonstrated these facts soon after the publications of Dr. Polli led to an enthusiastic administration of these remedies in the zymotic diseases.

THERAPY.—Dilute sulphurous acid is one of the numerous local applications considered efficacious in *mercurial stomatitis*, *aphthæ*, *mucous patches*, *ulcers of the tonsils*, and in *diphtheria*. In all of these affections the diluted acid may be applied directly to the diseased surface by a mop, a sponge-probang, or in the form of spray. A more easily managed application is a solution of the sulphite of soda (ʒ j— ℥ j in water).

In certain kinds of *vomiting* of a yeast-like material, especially when *sarcina* are present in the vomited matters, the sulphites are often curative. Vomiting of *acid matters*, *pyrosis*, and *indigestion*, due to *acid fermentation* of the starchy and saccharine elements of the food, are relieved by sulphurous acid (♏ v— ʒ j, well diluted), or, but less efficiently, by sulphite of soda (℈ j— ʒ j). The result in these cases is, no doubt, due to the power which sulphurous acid has of arresting the fermentation processes.

Sulphurous acid has been utilized of late in the treatment of phthisis, by rectal injection and by inhalation. A reaction has already begun against the use of the rectal injections—for they are troublesome to execute, and after a while the rectum becomes irritable. Inhalation of the gases, however, is increasing in favor. Dr. Dewar's warm advocacy of sulphurous acid was never tested in its results to any extent. Now, however, it is seen that his mode of treatment has much to recommend it, and was then in advance of his time. More effective, the author finds, is the "Pictet liquid"—which consists of sulphurous-acid gas and carbonic-acid gas liquefied by pressure and kept in siphon-bottles. A small quantity of this can be given out in the air of the apartment occupied by the patient. Care must be used to rightly gauge the quantity to the susceptibility of the patient.

Sulphurous-acid spray is a good local application in *syphilitic* and *tuberculous laryngitis*. Cases of *chronic bronchitis*, with profuse expectoration of a fetid character (bronchorrhœa), are sometimes improved by inhalations of sulphurous-acid gas, or of the acid in the form of spray.

Externally applied, sulphurous acid and the hyposulphites and sulphites are in some maladies extremely serviceable.

As a *disinfectant* and *deodorizer* sulphurous acid is at the same time efficient, easily managed, and economical. Sulphurous acid is the product of the combustion of sulphur in the open air; hence, to disinfect rooms, it is necessary only to close all egress and fill them with the fumes of burning sulphur. It is to be remembered that sulphurous acid is injurious to many fabrics. The sulphites are colorless and soluble.

Sulphurous acid is an efficient application to *chilblains:* ℞ Acid.

sulphurosi, ʒ iij; glycerini, ʒ j; aquæ, ℥ jss. M. In *parasitic skin-diseases,* the sulphites, hyposulphites, and sulphurous acid are used to destroy the parasites. The following formula is employed by Startin in these affections: ℞ Sodii hyposulphitis, ℥ iij; acid. sulphurosi dil., ℥ ss; aquæ, q. s. ad ℥ xvj. Fox recommends the following formula in *tinea versicolor* and in *pruritus vulvæ:* ℞ Sodii hyposulphitis, ʒ iv; glycerini, ʒ ij; aquæ destil. ad ℥ vj.

Sulphurous acid is an excellent application to *ill-conditioned, sloughing,* or *gangrenous wounds.* It was very successful in these cases, at the English hospital at Metz, during the Franco-German War.

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Sulphur and Sulphides (Sulphurets).—*Potassa Sulphurata.* Sulphurated potassa has a brownish-yellow color when freshly broken. It dissolves in water, with the exception of a slight residue, and forms an orange-yellow solution, which exhales the odor of hydrosulphuric acid. Dose, gr. j—gr. v.

Calx Sulphurata.—Sulphurated lime. A mixture containing at least 60 per cent of calcium monosulphide. A greenish-gray powder, having a strong odor of sulphureted hydrogen. Dose, gr. j—gr. v.

Antagonists and Incompatibles.—Solutions of the sulphides are decomposed by the mineral acids, sulphureted hydrogen being liberated and sulphur precipitated. Solutions of the metals, generally, are also incompatible with the sulphides of potassium and calcium, for, in the decomposition which ensues, the metals are precipitated in the form of insoluble sulphides. Hence it is that these preparations have been proposed as antidotes to the metallic poisons. Chlorine-water, chlorides of sodium and potassium, sulphate of iron, etc., are chemical antidotes.

Synergists.—All agents promoting waste are, therapeutically considered, synergistic. Alkalies favor their action, both chemically and physiologically.

Physiological Actions.—These preparations have a decidedly nauseous taste and smell, and are somewhat irritant. In the stomach they excite a sense of heat, and in sufficient quantity cause gastro-enteritis, with all the attendant symptoms belonging to irritant poisons. Disagreeable eructations of sulphureted hydrogen take place when they are administered medicinally, owing to the reactions in the presence of an acid alluded to above. They stimulate the secretion of the gastro-intestinal canal, and are laxative. The fetor of the stools is increased by their use, a result not altogether due to the evolved sulphureted hydrogen, but to the increased action of those intestinal glands concerned in elimination. As the sulphides pass easily to the state of sulphates by the action of oxygen, it may be assumed that a part of their physiological effects is produced by the latter salts. They, however, undoubtedly exercise a toxic action on the blood, impairing the red blood-globules, and increasing the amount of effete material. Emaciation, muscular weakness, and trembling, and a feeble circulation, are results of their use in large amount, or for lengthened periods. It is true that some acceleration of the pulse-rate and increase of secretion of the mucous surfaces follow their medicinal administration for a short period and in moderate doses; but the prolonged inhalation of sulphureted hydrogen, or the prolonged internal use of the sulphides, causes great anæmia, wasting, and debility.

THERAPY.—The waters of the well-known Blue Lick Springs, and others, of Kentucky, which are almost identical in composition with the famous Harrogate, of England, may be substituted for the sulphides in many of the cases in which the latter are useful.

The Blue Lick waters are useful in *abdominal plethora.* A pint taken before breakfast is an *efficient laxative,* which is indicated in cases of habitual constipation from deficient secretion of the intestinal juices. Four ounces taken before each meal is an excellent remedy for *obesity. Engorgement of the pelvic viscera* in women, and *hæmorrhoids* in both sexes, when due to torpor of the portal circulation, are relieved by the same agent. For these purposes the Blue Lick waters may be taken for several weeks or even months, but their use should be discontinued when anæmia is threatened. In anæmic subjects, chalybeates and a generous diet should be conjointly administered. The author has observed excellent results from the prolonged use of this water in *glandular affections, hepatic, splenic, uterine, and of the prostate.*

A succession of *common boils, scrofulous and other abscesses,* are, it is said, made to mature, and the expulsion of the pus is favored by the use of the sulphides. When abscesses are threatened, and before matter is formed, the sulphides, it is claimed, may cause them to abort. Small doses (gr. ss—gr. j) frequently repeated (every hour or two) are said to be most effective under these circumstances. Since the publication of the last edition of this work, rectal injection of gases obtained from natural waters corresponding in composition to the Kentucky Blue Lick has been brought forward. A century ago Priestley and others advocated this expedient, but the method did not appeal to the practical talent of the profession, and hence fell into complete desuetude. Its revival was due to the discovery of Bernard, that sulphureted-hydrogen gas and carbonic-acid gas, when thrown into the rectum, escape quickly from the lungs, and hence do not reach the nerve-centers. In passing through the lungs, morbid processes, morbific germs, etc., are acted on by the gas. The discovery of the *bacillus tuberculosis* was the next step, and after this the utilization of Bernard's discovery. Already the rectal injection of the gases is being superseded by the more direct and facile inhalation of the same agents.

EXTERNAL USES OF THE SULPHIDES.—A solution of the sulphide of potassium (ʒ ss—℥ j) is an efficient application in *scabies*. An extemporaneous sulphide may be made by boiling one part of quicklime and two parts of sublimed sulphur in ten parts of water. With this solution the parts affected by scabies may be painted over, after preliminary cleansing with a warm bath. Sulphur-baths (solution of sulphide of potassium in water, as above mentioned) are very excellent applications in the chronic forms of *psoriasis* and *eczema*. The following formula is recommended by Fox in *scabies* and *prurigo:* ℞ Potassii sulphureti, ℥ vi; sapon. alb., ℔ ij; ol. olivæ, Oij; ol. thymi, ʒ ij. M. A milder preparation is the following: ℞ Potassii sulphureti, ʒ iij; sapon. moll., ℥ j; aquæ calcis, ℥ viij; alcohol, ℥ ij. M. Or the following: ℞ Potassii sulphureti, ℥ ss; aquæ calcis, ℥ xvj. M. For the relief of *pityriasis* and *parasitic skin-diseases*.

The sulphide of sodium (unofficial) being more stable, is better suited for the preparation of sulphurous baths. An artificial sulphurous water, in imitation of the *Barèges*, is made as follows: ℞ Sulphidi sodii, sodæ, sodii chloridi, āā ℥ ij. M. Sig.: A sufficient quantity for one bath. The *Pommade de Barèges* of the French is constituted as follows: ℞ Sodii sulphureti, sodii carbonat., āā ʒ ij; axungiæ, ℥ ijss. M.

Sulphur-baths are frequently employed to favor the elimination of lead, in cases of *saturnine disease*.

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SULPHUROUS MINERAL WATERS.

1. NORTH AMERICA.

French-Lick Springs.

West-Baden Springs, Orange County, Indiana.

Indian Springs, Martin County, Indiana.

These waters contain carbonates of soda, potassa, magnesia, and lime, and chlorides of sodium, potassium, magnesium, and calcium, and sulphates of soda, magnesia, lime, and potassa. The gases are sulphureted hydrogen and carbonic-acid gas.

Upper Blue-Lick Springs, Nicholas County, Kentucky.

Lower Blue-Lick Springs, Nicholas County, Kentucky.

Big-Bone Springs, Boone County, Kentucky.

Paroquet Springs, Bullitt County, Kentucky.

These waters are remarkable for the quantity of sulphureted hydrogen which they contain (from 1·02 cubic inch to 3·75). They are rich in the chloride of sodium (from 38·700 grains to the pint to 64·567 grains). They contain also chlorides of potassium, sodium, magnesium, and calcium, carbonates of soda, magnesia, iron, and lime, sulphates of soda, potassa, and magnesia, and appreciable quantities of iodides and bromides.

Alpena Well, Alpena County, Michigan.

This water contains the large quantity of 4·42 cubic inches of sulphureted hydrogen to the pint. The proportion of chloride of sodium is small (8·532 grains to the pint). The other ingredients are carbonates of soda, magnesia, iron, and lime, and sulphate of lime.

Sharon Springs, Schoharie County, New York.

Avon Springs, Livingston County, New York.

Mild sulphureted waters. The principal salt is sulphate of lime, which is found in the different springs, ranging from 11·687 grains to 13·95 grains to the pint (Sharon).

Yellow-Sulphur Springs, Montgomery County, Virginia.

The most important constituents of these waters are sulphates of lime, magnesia, soda, potassa, and alumina, and carbonates of lime, magnesia, and iron. The gas is carbonic acid and sulphureted hydrogen.

Greenbrier White-Sulphur Springs, West Virginia.

Salt-Sulphur Springs, Monroe County, West Virginia.

Red-Sulphur Springs, Monroe County, West Virginia.

These springs are nearly alike as respects the composition of their waters. They contain chlorides and sulphates, but their principal constituents are sulphate of lime, sulphate of soda, and sulphate of magnesia. The Greenbrier Spring and the Red-Sulphur Spring waters contain also a peculiar sulphur compound, in regard to the nature of which but little is known.

2. European.

Harrogate, Yorkshire, England. Season from May to September.

These waters contain chlorides of calcium, magnesium, potassium, and sodium, carbonic-acid gas, and sulphureted hydrogen.

Llandrindod, Wales.

Saline, chalybeate, and sulphur waters ; rich in chlorides, especially of sodium.

Strathpeffer, Ross-shire, Scotland.

This is a strong sulphureted water, and contains sulphate of lime, carbonate of lime, sulphate of magnesia, and sulphate of soda.

Moffatt, south of Scotland.

The waters contain chloride of sodium (28·07), sulphate of soda, sulphate of lime, and sulphureted-hydrogen gas.

Baréges, Hautes-Pyrénées. Altitude, 4,000′. Temperature, 86° to 113° Fahr. Season from July to September.

Waters contain sulphide of sodium, sulphate of soda, chloride of sodium, etc.

These waters are used chiefly for bathing the patients, beginning with the colder and passing on to the hotter waters. These springs have a special celebrity for the treatment of old wounds, diseases of bones, and rheumatic and neuralgic affections.

Cauterets, Hautes-Pyrénées. Altitude, 3,000′, but sheltered. Season, June to September. Temperature of baths, 98° to 131° Fahr.

The composition of the waters is similar to that of those of Baréges, but it is more stimulating, and contains a good deal of iodine. It is especially advised in incipient tuberculosis, bronchial affections, and pelvic diseases of women.

Eaux-Bonnes, Basse-Pyrénées, near Pau. Altitude, 2,000′.

Waters sulphurous and saline, similar to but not so exciting as those of Baréges. This resort is celebrated chiefly for its effects in laryngeal diseases and clergyman's sore-throat.

Challes, Savoy.

This water, according to Macpherson, is one of the most remarkable in Europe, and "is the strongest sulphur-well known." It contains iodine and bromine, sulphide of sodium, bromide of sodium, etc.

Aix-la-Chapelle, Rhenish Prussia. Altitude, 450′. Temperature of air during season, mean, 63° Fahr. Season from June to September.

According to Liebig's analysis, these waters contain chloride of sodium (20 grains), bromide, iodide, and sulphate of sodium, carbonate of soda (4·9 grains), sulphate of soda (2·1 grains), sulphate of potash (1·1 grain), and carbonates of lime, magnesia, strontia, lithia, etc. Used by drinking and bathing, and especially in cutaneous diseases, rheumatism, syphilis, hepatic disorders, etc.

Eilsen, Lippe-Schomburg, Northern Germany.

Neundorf, Prussian Westphalia.

These waters contain the sulphates of soda, magnesia, lime, and chlorides of calcium and magnesium. They are highly charged with carbonic-acid gas and sulphureted hydrogen. They are useful in gouty and rheumatic affections, syphilis, skin-diseases, etc.

Schintznach, Switzerland. Altitude, 1,060′.

This is a highly-sulphurous water, and is charged with carbonic-acid gas and sulphureted hydrogen. It contains sulphate of soda

(9.87 grains), sulphates of potash and lime, chlorides of potassium and magnesium, and carbonates, etc.

Therapy of the Sulphur-Waters.—Of the sulphurous waters given above, those belonging to this country are quite unsurpassed in therapeutical value. As a rule, such waters are useful in *liver-disorders ;* they diminish *abdominal plethora*, and *congestion* of the *portal circulation.* They are indicated in *malarial affections of the liver and spleen. Rheumatism and gout, tuberculosis in its incipiency, chronic poisoning by the metals*, etc., are certainly benefited by the internal use, and by baths of sulphurous waters. *Affections of the skin, syphilitic diseases, chronic rheumatic affections*, etc., are especially forms of disease remediable by these waters, used internally and in the form of baths.

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IODINE AND ITS PREPARATIONS.

Iodum.—*Iode*, Fr. ; *Iod*, Ger. ; *Iodum*, Latin.

Iodum.—Iodine. In bluish-black crystalline scales, having a metallic luster ; very slightly soluble in water (1 in 5,000) ; soluble in alcohol (1 in 10), in ether, in a solution of iodide of potassium, and in a solution of chloride of sodium. Dose, gr. ss—gr. j.

Iodoformum. — Iodoform. In yellow crystals, having a saffron odor. Insoluble in water, but soluble in ether and the fixed and volatile oils. Dose, gr. j—gr. v.

Liquor Iodi Compositus.—Compound solution of iodine. Iodine, 5 grm. ; iodide of potassium, 10 grm. ; distilled water, q. s. to make 100 grm. Dose, ♏ v—♏ xx.

Tinctura Iodi.—Tincture of iodine. Iodine, 70 grm. ; alcohol, to 1,000 grm. Dose, ♏ j—♏ v.

Unguentum Iodi.—Iodine ointment. Iodine, 4 grm. ; iodide of potassium, 1 grm. ; water, 2 c. c. ; and benzoinated lard, 93 grm.

Syrupus Acidi Hydriodici.—Sirup of hydriodic acid. A sirupy liquid, containing about one per cent by weight of absolute hydriodic acid. Dose, ʒ ss—ʒ ij.

Sulphuris Iodidum.—Sulphur iodide. In brittle masses of a crystalline fracture, a grayish-black metallic luster, and having the odor of iodine. Dose, gr. ¼ to gr. j.

Unguentum Potassii Iodidi.—Ointment of potassium iodide. Potassium iodide, 12 grm.; sodium sulphite, 1 grm.; boiling water, 10 c. c.; benzoinated lard, 77 grm.

Ammonii Iodidum.—Ammonium iodide. A white, granular, very deliquescent salt, becoming yellowish-brown by exposure. Very soluble in water and in alcohol. Dose, gr. ij—gr. x.

Potassii Iodidum.—Potassium iodide. In white or transparent crystals, wholly soluble in water at 59° Fahr. in 0·75 part, and in alcohol (1 in 18). Dose, gr. v—ʒ j.

Sodii Iodidum.—Sodium iodide. In minute crystals, or crystalline powder, deliquescent, having a saline and bitter taste and an alkaline reaction. Soluble in water and in alcohol. Dose, gr. ij—℈j.

Antagonists and Incompatibles.—Iodine is incompatible with the mineral acids, the metallic salts, the vegetable alkaloids, etc. The chemical antidote is starch, or substances containing it, as flour. These should be given freely diffused in water. It should be remembered that starch is the antidote to free iodine. As, however, the *iodide of starch* is not devoid of activity, in cases of poisoning by iodine the contents of the stomach should be evacuated. It is obvious that the preparations of iodine, taken after a meal consisting of amylaceous materials, will have their activity impaired by the formation of the iodide of starch, the acid of the stomach freeing the iodine from its chemical association.

Synergists.—Alkalies, and other remedies which increase waste, favor the action of iodine and the iodides. Under some circumstances, mercurials are especially synergistic.

Physiological Actions. — *Iodine.*—When brought into contact with albuminous substances, iodine combines with it and prevents putrefactive change. The vapor of iodine, like chlorine, but in a feebler degree, decomposes sulphureted and phosphureted compounds. It is, therefore, justly ranked among the disinfectants.

Applied to the skin or mucous membrane, iodine, according to the extent of the application, is irritant or caustic. It stains the skin yellow, causes a sensation of warmth in small quantity, or of burning in larger quantity, and excites a superficial inflammation followed by desquamation. In some subjects the application of iodine-paint causes vesication. Pure iodine, kept in contact with the tissues, produces a brown and dry eschar. The vapor of iodine is very irritant to the broncho-pulmonary mucous membrane, causing cough, spasm of the glottis, and increased flow of mucus.

Iodine has a hot, pungent flavor, and excites a sensation of heat or burning in the stomach. In sufficient quantity, it acts as an irritant poison, inflames the mucous membrane of the stomach, and causes superficial eschars. The amount of iodine necessary to produce toxic symptoms varies greatly, and the variation depends in part on constitutional peculiarities, but chiefly on the amount and quality of the food in the stomach. Whether applied to the surface of the skin or taken into the stomach, it quickly diffuses into the blood, and enters into combination with sodium or potassium, or with both.

Iodides.—The iodides are among the most diffusible substances. They have a bitter, saline, and very disagreeable taste. In a few minutes after being swallowed, the taste of iodide of potassium returns in the mouth, and, during a course of this salt, the saliva is constantly charged with it. In the stomach, in considerable doses, they produce first a cooling sensation, followed by warmth, and even burning. They pass into the blood with great rapidity. It is said that the base is changed in the blood, and the iodides of ammonium and potassium become iodide of sodium. In the blood they probably undergo no further changes, and do not, so far as is known, modify the composition of that fluid. At the points of elimination from the free mucous surfaces (nasal, faucial, and bronchial mucous membrane), the chemical changes which ensue set free ozone, and the irritation there experienced is probably in part due to the iodine, separated from its combinations by the action of that agent (Buchheim). Elimination doubtless takes place by the broncho-pulmonary, faucial, and salivary glands, but chiefly by the kidneys. The diffusion of the iodides into and out of the blood takes place with such rapidity that in fifteen minutes they may be detected in the saliva and in the urine.

Diverse opinions have been expressed in regard to the influence of the iodides over the assimilative functions. By the syphilographers it is held that the iodides promote constructive metamorphosis, and that a gain in body-weight is a result of their use. This opinion is developed in this way : The subjects of syphilis in its constitutional form emaciate, and their forces are depressed ; but, when the iodides are given them, the virus is eliminated, and the organism at once reacts. In the physiological state the iodides increase waste and the elimination of the products of waste, and emaciation with a general depression of the vital functions ensues, when they are administered for lengthened periods.

The proof of the statements just made has been afforded us by the researches of Duchesne, who has ascertained that a decided increase in the amount of urea excreted results from the action of the iodides, especially of the iodide of potassium, and this enhanced metabolism of the nitrogenous elements persists for several days after their administration has ceased. Bouchard, so long ago as 1872, had ascertained the same fact. The other iodides—of ammonium, sodium, and calcium—act in a similar manner during the time of their administration, but their subsequent effects are far feebler and shorter in duration.

The tincture of iodine acts in a manner similar to iodide of potassium, but it has a more powerful effect in increasing nitrogenous waste, as represented in the excretion of urea. An important observation has been made by Duchesne as to the influence of iodine in the condition of interstitial nephritis with albuminuria. He notes that when increasing doses of the tincture are given, the quantity of albumen lessens and finally disappears entirely. As the actions of iodine and of its combinations are really so different in character as well as in power, it becomes important to ascertain which may be the better fitted for particular service. *Lasègue* had, long ago, empirically ascertained that tincture of iodine should be preferred to iodide of potassium, whenever it is necessary to stimulate the retrograde metamorphosis—to increase oxidation, or to enact the part of "*alterative.*"

Iodism.—When the prolonged administration of iodine or iodides becomes necessary, certain precautions must be observed to prevent the development of iodism. Especially will such precautions be necessary when massive doses of iodides are administered through many months and years in cases of arterio-sclerosis. Prof. Sée maintains that by occasional intermissions, and the use of eliminants at such times, iodism may be prevented.

Ehrlich, and subsequently Krönig, have ascertained that sulphanilic acid has the power to prevent or arrest iodism. The action is a chemical one, and is explained thus: the phenomena of iodism are due to the presence of free iodine, and this agent is separated from its combinations by the nitrates in the presence of a weak acid. As sulphanilic acid has a strong affinity for nitric acid, the reaction which frees iodine is prevented.

Atropine is quite effective as a remedy for iodism, by arresting the morbid action taking place on the mucous surface, where the recombination of iodine is taking place (Binz). Some of the rashes, hydroa, etc., which belong to iodism, are also removed by atropine. The acne the gastric disturbances, and the depression of the vital powers, are to some extent favorably affected by arsenic, and hence, if there be no contraindications, it can be given in the same prescription with the iodides. It is iodine, rather than the iodides, when given in large quantity, that produces the state termed *iodism.* The quantity which will set up this state of irritation in one subject will affect another but slightly, if at all; in other words, the susceptibility to the iodine impression varies greatly in different individuals. Iodism is manifested by general *malaise* and rise of temperature, frontal headache, coryza, lachrymation, and sometimes inflammatory swelling of the eyelids, a bittter saline taste in the mouth, soreness of the throat, hoarseness, and difficulty of swallowing—phenomena strikingly similar to summer catarrh. Indeed, patients who experience these sensations for the first time, suppose them to be an acute catarrh. Usually the symptoms of iodism subside, notwithstanding the dose which caused them may still be taken, or, as it may be expressed, a "tolerance" is established. The quantity which at one time may have caused violent iodism will not necessarily again do so, although a considerable interval may have elapsed. Indeed, it is sometimes difficult to induce iodism in those who have become habituated to the use of the iodides in considerable medicinal doses.

An eruption of acne, especially on the face, shoulders, and thighs, is a very common result of the internal use of the iodides; hydroa on the face and forehead is an occasional consequence, but eczema is more frequent, yet less so than acne, which is usual.

Wasting of the mammæ and of the testes has never been observed by the author, although he has used the largest doses of the iodides, for long periods. There is no doubt about their antaphrodisiac effects, and it has seemed to the author that permanent loss of sexual power has resulted from their long-continued use.

When it is desirable to avoid iodism, large draughts of water should be taken during a course of the iodides. As Rosenthal has shown, large dilution of the salt hastens elimination, and thus prevents the more severe effects of iodism.

Benedict has experimentally studied the effects of iodine and of iodide of potassium on the nervous system. His observations, made on frogs, demonstrated that these agents caused paralysis of the heart and of the respiration. Schule reports a case in which such symptoms were induced by injecting the sac of a *spina bifida* with tincture of iodine, but the direct and reflex effects of the injection on the spinal cord may have had much to do with the result.

Therapy.—The selection of an iodide for internal administration is influenced by the type of the individual, by the condition of the heart, and by the purpose to be subserved. If an idiosyncrasy to the action of an iodide exist, its nature and power should be ascertained. When the combinations of iodine with alkaline bases can not be taken, iodide of starch—"amylum iodatum"—may be substituted, and, although not so efficient as a remedy, is far less likely to cause acute iodism, or to set up a gastric catarrh. Also, as the salts of potassium have a more depressing effect on the heart than the corresponding sodium salts, the latter are preferable when long-continued administration is required. On the other hand, if the circulation is active and the forces unabated, iodide of potassium will prove more effective.

The *vomiting of pregnancy* can sometimes be greatly relieved by drop-doses, every hour or two, of the tincture of iodine. This, like all other remedies for this disorder, is very uncertain, and precise indications for its use have not hitherto been ascertained. *Catarrh of the duodenum, catarrh of the biliary ducts*, and the *jaundice* dependent thereon, are, after the acuter symptoms have subsided, greatly benefited by the smaller doses of iodide of sodium or ammonium. This is one of the best remedies for the first stage of *cirrhosis*. The efficacy of the iodide is increased by combination with arsenic: ℞ Ammonii iodid., ʒ j; liq. potassii arsenitis, ʒ ss; tinct. colombæ, ℥ ss; aquæ, ℥ jss. M. Sig.: A teaspoonful three times a day, before meals.

The preparations of iodine and the iodides are, generally speaking, contraindicated in all inflammatory states of the intestinal canal; but in *passive hæmorrhage*, and *diarrhœa* from atony of the mucous membrane, the tincture or compound solution of iodine in small doses—one or two drops—frequently repeated, renders important service (Schmidt).

Large doses (grs. xv—ʒ ss) of the iodide of potassium, three or four times a day, often afford remarkable relief in *aneurism*, and sometimes effect a cure. The author has seen several instances in which great benefit was derived from it, and one case certainly in which a cure apparently resulted. He is, therefore, able to confirm the observations of Chuckerbutty, Roberts, Balfour, and others.

In *arterio-sclerosis* and in *sclerosis* of the *heart, kidneys*, and other organs, our French colleagues maintain that the iodides possess distinct curative power, if given in sufficient quantity, for several years. About one drachm daily is the minimum amount that will accomplish the object. As, however, the potash base is more injurious in action than the soda base, the iodide of sodium should be preferred for this purpose. Prof. Sée, Heuchard, and others of the French school, are convinced that the condition of sclerosis, which, as it affects the arterial system, plays an important part in pathogeny, can be arrested, the morbid deposits removed, and the integrity of the vessels restored. Prolonged use of the iodide of sodium, although not without its disadvantages, can be safely carried on if occasional intermissions are allowed.

In *summer catarrh* or *hay-asthma*, the best results are obtained by the use of larger doses, and the efficacy of the iodides is increased by combination with arsenic: ℞ Potassii iodidi, ℥ j; liq. potassii arsenitis, ʒ j; aquæ, ℥ iv. M. Sig.: A teaspoonful every four or six hours. With the internal use of the iodides may be combined the local use, to nares and fauces, of the following solution: ℞ Tinct. iodinii, ʒ j; acid. carbol., gtts. x; aquæ destil., ℥ iv. M. Sig.: Apply with a post-nasal syringe. Ethyl iodide is especially valuable inhaled frequently.

The iodide of potassium is one of the most effective remedies which we possess for *spasmodic asthma*. But it is not adapted to all cases arising under various conditions—a fact which explains the difference of opinion on the subject between Williams, Salter, and others. It is most beneficial when the asthmatic seizures are reflex. Salter, however, holds that we possess no exact indications for its use, and that cases the most diverse are sometimes benefited in a remarkable manner.

Chronic bronchitis, with profuse secretions (bronchorrhœa), is frequently improved by the iodides, more especially the iodide of ammonium. The efficacy of this remedy is increased by the conjoined administration of arsenic. In *capillary bronchitis*, the author has witnessed most astonishing relief by the rapid administration of iodide of ammonium in small doses. It may be combined with the carbonate, or with the stimulant expectorants. To remove the deposited inflammatory exudations of *catarrhal* and *fibrinous pneumonia*, no remedy is more efficient than the iodide of ammonium. To lessen the effect of this remedy on the tissue-changes, arsenic should be combined with it, and every means used to support the body nutrition. The iodide of potassium is one of the remedies resorted to in *chronic pleurisy*, to promote absorption of effusions. In these cases the iodides are administered steadily for a considerable period, and pilocarpine given, as may be necessary, to increase the sorbifacient action.

Affections of the broncho-pulmonary mucous membrane, alluded to above, in which there is profuse exudation, all inflammatory symptoms having subsided, are advantageously treated by iodine inhalations. The method which the author has found most convenient is the following: A small, wide-mouthed bottle, containing a moistened sponge, is placed in a vessel of hot water. The tincture of iodine (gtts. v—gtts. x) is dropped upon the sponge, and, as the vapor of iodine rises, is inhaled with the vapor of water. This inhalation is serviceable in *acute catarrh*, *hay-asthma*, and *chronic bronchitis*. The carbolate of iodine (tinct. iodi, ʒ ij; acid. carbol., ʒ j) may be used instead of the simple tincture of iodine. Ten to twenty drops for inhalation.

But few affections of the brain, non-specific in origin, are benefited by the iodides. According to Niemeyer, the iodide of potassium given to iodism has in few instances cured *basilar meningitis*. The author, who has used it faithfully in various cases, has not been so successful. Trousseau et Pidoux express their disbelief in the reported cures of tubercular meningitis by this agent. Seguin maintains, on the other hand, that remarkably good results sometimes follow the use of large doses of the iodides in other than specific diseases—in the various subacute and chronic inflammatory affections of the meninges and brain.

No remedy is more efficient in the treatment of certain glandular enlargements of the thyroid, spleen, and lymphatic glands. *Goitre* is curable by the internal and external application of iodine, when it consists of simple hypertrophy of the gland-elements. Cystic and calcareous degeneration of the thyroid are unaffected by the use of iodine preparations never so vigorously used. One of the best remedies for true goitre, as will be seen hereafter, is the unguentum hydrarg. iodidi rubri. *Enlarged spleen*, when it consists merely of an hypertrophy of the organ (chronic splenitis), is cured by the internal use of the iodides conjoined with the local use of iodine-paint, or ointment of the red iodide of mercury. The *enlargements* of the *spleen and liver*, with *functional derangement of these organs*, which are caused by malarial disease, are most effectually removed by moderate doses, frequently repeated, of the iodide of ammonium. The author's experience justifies him in strongly urging the combined use of iodide of ammonium and arsenic in *chronic malarial poisoning.*

The prolonged administration of the iodides has the power to retard the growth and to remove the changes which ensue in *chronic Bright's disease* (fibroid degeneration), and the arterio-sclerosis accompanying it.

The utility of the iodides is most conspicuous in certain *constitutional states.* The expectations which were at first entertained of the cure of *scrofula* by iodine and its preparations have not been realized. The iodides are unquestionably useful in the *scrofulous* (so called) *enlargements of the lymphatic glands,* but cod-liver oil and suitable hygienic means are more influential in improving the strumous diathesis. The preparations of iodine are effective only when simple hypertrophy of the lymphatic glands has taken place; if they have undergone caseation, or have proceeded to suppuration, no medicine has any influence over them.

The most important therapeutical applications of the preparations of iodine are in the treatment of *constitutional syphilis.* For the primary and secondary stage, mercury is generally admitted to be best; but for tertiary symptoms no remedy at all approaches the iodide of potassium. In the secondary affections of the skin, mercury, especially if it have not been given for the primary troubles, is to be preferred in the papular, tubercular, squamous, and pustular syphilides; iodide of potassium in the ulcerating, especially if the patient is cachectic. It may be stated in general that the preparations of iodine are indicated when the patient is under the mercurial cachexia. On the other hand, it is well known that sometimes, even when the tertiary symptoms have not been relieved by a thorough course of iodides, mercury will quickly remove them. But this fact does not invalidate the rule that the iodides are specially serviceable for the tertiary period.

No therapeutical fact is more conspicuous than the cure of *syphiloma of the nervous system* by iodides. *Mental disorders, epileptiform seizures, paralytic states,* etc., dependent on gummata, nodes, etc., are usually removed in a manner little short of magical. *Neuralgia of the fifth* (*tic-douloureux*), the pain being nocturnal chiefly, or *nocturnal pain in the head,* is similarly promptly cured. In syphilitic affections of the brain, more imperatively than in the same affections of other organs, are large doses of the iodide of potassium required. The limitation of the dose depends entirely on the physiological susceptibility of the patient, and the influence exerted over the progress of the case. Hence the dose may vary from ten grains to a drachm every four hours, or three or four times a day. The symptoms of iodism—the use of the agent to saturation—should be induced; for this effect is the only measure of the therapeutical power of the remedy. The more promptly iodism can be induced, the better, for the soft nervous tissue may be quickly and irreparably damaged by syphilitic deposits and new growths. *Syphilitic paraplegia* is equally amenable to the same means; but, as above remarked, much depends on the promptness with which the iodide is used.

Recent experience has conclusively shown the curative power of iodine in *malarial fevers.* Thus three hundred consecutive cases were, with few exceptions, promptly arrested (Anderson). In some cases no paroxysm occurred after the medicine was administered; sometimes the attacks persisted for two or three days, but then the relief was complete. The official compound tincture of iodine may be prescribed —for adults, ten to fifteen minims, three times a day, well diluted, and before meals. Carbolic acid, itself having considerable anti-periodic power, may be combined with the tincture of iodine. ℞ Tinct. iodi, ℥ ij; acid. carbolic., ʒ ij. M. Sig.: Ten to fifteen minims three or four times a day. The tincture of iodine is stronger than the compound tincture. If quinine be necessary to break up the paroxysms, iodine is highly useful in the interim, as has been indicated. Some recent experiences by Dr. Atkinson, of Baltimore, throw doubts on the previous statements. He found that iodine failed in two thirds of the cases of intermittent fever.

The use of the compound solution of iodine during the course of the first and second week of *typhoid fever* is known in Germany as the "specific treatment." A very considerable reduction in mortality appears to have followed this method. The solution of iodine or the tincture is administered regularly three times a day, well diluted with water. When it does good, the temperature falls, the nausea lessens, and the diarrhœa is restrained within safe limits.

Chronic rheumatism, when there are present thickening of the fibrous tissues, and inflammatory depositions about joints, tendons, periosteum, and nerve-trunks, is often very signally benefited by the iodides. The cases in which these remedies prove so serviceable are most probably due to syphilitic, mercurial, saturnine, or other constitutional causes. There are, in our modern life, many ways in which these mineral poisons enter the organism, and it is probable that they are often undiscovered and even unsuspected causes of rheumatic symptoms. *Lumbago*, *sciatica*, and *paraplegia*, apparently of rheumatic origin, and curable by the iodides, may not unfrequently be caused by syphilis, mercury, copper, tin, or lead.

The *various accidents caused by the metals above named*, especially the *mercurial* and *saturnine*, are removed by the use of the iodides, notably by the iodide of potassium. With regard to the dose necessary, what is true of syphilis is equally true of the mineral poisons: in order to remove them, the organism must be saturated by the remedy. From fifteen grains to a drachm, three or four times a day, should be given; but the measure of the quantity required is the effect pro duced. The iodides penetrate into every tissue, convert the deposited metal into soluble combinations, and cause them to be discharged by the various organs of excretion, chiefly by the kidneys. It has been repeatedly asserted that salivation may be induced, and existing salivation increased, by the use of the iodides for the removal of mercurial salts from the organism; but the author has not witnessed any facts which support this statement.

In *skin-diseases of syphilitic origin* there can be no question as to the utility of the iodides. But these remedies are more especially curative in the tertiary affections, especially in destructive syphilitic ulcerations. Hebra insists, and with justice, that the preparations of iodine are only useful in *lupus*, whether syphilitic or scrofulous, and do not permanently improve other cutaneous diseases. Greve asserts that large doses of the iodides (℈j–ʒj *ter die*) rapidly cure *psoriasis;* and in this opinion specific origin is not said to be necessary to the curative result. Boeck confirms Greve's statements.

LOCAL USES OF THE PREPARATIONS OF IODINE.—The tincture of iodine is in universal use as a counter-irritant. It is applied by means of a camel's-hair brush to *goitre*, to *enlarged glands*, and to superficial *inflammatory swellings* before the formation of pus. Painted over the neck, it is a useful counter-irritant in *acute affections of the pharynx and larynx*, and to the chest to relieve the *chest-pains* which occur in *phthisis*. It is the most serviceable counter-irritant to promote absorption of inflammatory products in *catarrhal* and *fibrinous pneumonia* after the acuter symptoms have subsided. The same application appears to possess the power to promote the absorption of *pleuritic effusion*. It is a good plan in these affections to paint, on successive days, the tincture over the front, the lateral, and the posterior wall of the chest, so that one surface has time to recover from the irritation before it is again attacked. As the susceptibility to the action of the iodine varies in different subjects, it is always prudent to make a slight application in the beginning. If extreme burning follow the applications, the iodine may be dissolved off by a solution of iodide of potassium, by alcohol, or ether.

The tincture and the ointments of iodine are also used to remove the *induration of the breasts* which results from attacks of inflammation. It must be remembered that the integument in this situation is extremely sensitive to irritating applications. *Splenic and hepatic disorders of a chronic kind* are frequently treated locally by the application of tincture and ointment of iodine. Enlarged spleen of malarial origin is more speedily cured by the application of the official red iodide-of-mercury ointment, and, as regards hepatic disorders, the only affection which has seemed to the author to be benefited by iodine applications is the engorgement due to malarial attacks.

After the acute symptoms have subsided, tincture of iodine will remove the swelling of *orchitis.* The scrotum, like the female breast, is very sensitive to the irritation of iodine tincture and ointments. *Bubo,* like the enlarged lymphatic glands in other situations, may be treated by the application of iodine-tincture, but it is not very effective.

Although Hebra does not approve of the internal use of iodine in cutaneous diseases, he advises the local application. He employs the tincture or glycerine solution in *chloasma, lentigo,* and *lupus.* The tincture of iodine is used to prevent the *pitting of small-pox.* According to Piringer, it should be applied as follows: If on the first day of the eruption, the whole face, including the eyelids, is brushed over with the tincture of iodine ten times, there being an interval of a half-hour between each application; if on the second day, twelve applications; if on the third day, twelve to sixteen applications. The tincture of iodine is sometimes painted over the affected surface in erysipelas, and over the surrounding healthy integument, to prevent the spread of the disease, but, according to the author's experience, it is bad practice.

Iodoform may be substituted for iodine in the form of the official ointment. This may be used locally, rubbed in, as the iodine-ointments are, for the relief of local inflammatory swellings, enlarged lymphatic glands, goitre, etc. The strong, diffusive, and peculiar odor of iodoform is an objection to its use in this way. Iodoform powdered and dusted over the diseased surface is an excellent application to *sloughing and ill-continued wounds, irritable ulcers, rodent ulcer, chancroid, sloughing phagedena,* and *serpiginous syphilitic ulcers.* It allays pain, changes the morbid action, and is antiseptic. *Syphilitic ulcers of the tonsils, pharynx, and tongue,* are most effectually treated by local and direct application of powdered iodoform. In these cases the powder may be blown on to the surface of the ulcer by an insufflator or insufflation-tube. *Fissures of the anus, hæmorrhoids and ulcers of the rectum,* are improved in condition, and the pain which attends them relieved by application of the ointment of iodoform and by iodoform suppositories. The latter are also of undoubted service in *chronic metritis* and *hypertrophy of the prostate* when introduced into the rectum; the iodoform diffuses into the neighboring organs, and acts directly upon them. The *pain of cancer* may be somewhat relieved, and the *fetid odor* which attends the discharges may be removed, by the application of iodoform to the diseased surface. This treatment may be applied to cancer in any situation, but is especially applicable to cancer of the uterus and rectum.

The *parenchymatous injection* of tincture of iodine is a remedial means of great importance. The method of employing it is exceedingly simple. An ordinary hypodermatic syringe (glass or hard rubber) is charged with five to fifteen minims or more of the tincture, and the needle is thrust deeply into the affected tissue, and the iodine is slowly discharged. For injection into parts very deeply situated, long needles, such as are made for aspiration, can be used. This method of treatment is very effective in *hypertrophied tonsils, goitre, glandular tumors,* and the *compound cystic and glandular growths* so frequently found in the neck. The author has witnessed the cure of many cases of this kind by the parenchymatous injection of tincture of iodine. Some precautions must be attended to in practicing these injections. When the point of the needle is inserted as deeply as desired, it should be moved about to disengage it from any vessels into which it may have penetrated. Recent observations (1887) by Terrillon and Sébileau have fully confirmed the opinion expressed above as to the value of iodine injections in the simple and fibroid goitre, and they express a decided preference for iodine tincture over the ethereal solution of iodoform, recently recommended.

When *hydrothorax* returns after evacuation of the cavity by the trocar, the compound solution of iodine or the tincture may be injected into the pleural sac. In *empyema,* the undiluted tincture of iodine may be thrown in without risk, and with great benefit. Ordinarily, a solution of the following strength may be used to wash out the cavity in cases of empyema : ℞ Liq. iodi comp., ℥ j ; aquæ, ℥ xv. M.

Hydatids of the liver may easily be destroyed by injecting into them a few drops of tincture of iodine. It has, however, been shown that in some instances simple capillary puncture and withdrawal of the fluid suffice to arrest the growth and to abort these parasites. Injection of tincture of iodine is one of the means resorted to to cure *hydrocele.*

It is said that *hypertrophied prostate* may be diminished and further enlargement prevented by parenchymatous injection of iodine. In the performance of this operation a Sims or bivalve rectal speculum is inserted, and the needle of the syringe is passed through the walls of the rectum into the gland. Careful palpation previous to the insertion of the needle will enable the operator to avoid important vessels.

Unilocular ovarian cysts may sometimes be cured by injecting into them, after the withdrawal of the fluid, ten to sixteen ounces of tincture of iodine. No other form of ovarian cyst will, however, be affected favorably by this expedient.

Large abscesses may be made to close much more speedily than they would otherwise, and septic infection be prevented, by the injection of iodine-tincture after the evacuation of the matter.

Numerous cases of *spina bifida* have been cured by the injection into the sac of tincture of iodine (ʒ ss), or a solution of iodine (gr. ss) and iodide of potassium (gr. v) in water (ʒ j).

Iodo-Tannin.—This is an excellent application for local diseases. Tannin may be dissolved to saturation in tincture of iodine, or an aqueous solution may be prepared as follows : ℞ Iodi, ʒ j ; acid tannici, ℥ j ; aquæ, Oj. After filtration, to be evaporated to ℥ iv.

The author has found a saturated solution of tannin in tincture of iodine is a most efficient application in all those cases of *uterine disease* in which the tincture of iodine and iodized cotton and iodized glycerin are now so much used. It is serviceable in *chronic cervicitis, chronic endo-metritis, sub-involution and hypertrophy of the uterus.* The author has also found that the following combination is a capital application in *leucorrhœa* and the above-named uterine affections: ℞ Iodoformi, ʒ j; acid. tannici, ℥ j. M. A sufficient quantity to be packed in the dry state around the cervix.

The *iodide of starch* is used by Mr. Marshall as a dressing for syphilitic ulcers, and he speaks highly of its efficacy.

A decolorized tincture of iodine for external use may be prepared as follows: iodine, hyposulphite of sodium, distilled water, of each ten parts. Dissolve with a moderate heat, and add sixteen parts of spirits ammonia, and, after a few minutes' agitation, add seventy-five parts of alcohol. The solution must stand in a cool place for three days, and then be filtered (Waldenburg und Simon). Decolorized iodine is of doubtful utility.

An extemporaneous *iodo-tannin* may be prepared according to the formula of Sigmund: ℞ Tinct. iodi, tinct. gallæ, āā ℥ ss. M. The strength of this may be increased by the addition of iodine ℈ij.

Acidum Iodicum.—Iodic acid. It occurs in the form of white crystalline tablets and masses, having a bitter taste, astringent, odorless, and freely soluble in water.

Iodic acid combines with bases to form salts, which are crystalline and freely soluble in water.

The dose of iodic acid is from gr. ⅙ to gr. j.

Sodii Iodas.—Iodate of sodium. Dose, gr. j to gr. x.

Potassii Iodas.—Iodate of potassium. Dose, gr. j to gr. x.

ACTIONS AND USES.—Iodic acid readily parts with its oxygen in the presence of reducing substances, depositing iodine. In contact with organic matter and with vegetable alkaloids—morphine, for example—it loses oxygen. When administered internally, it is reduced in its passage through the system, iodine appearing in the urine. It promotes appetite and digestion, favors the constructive metamorphosis, and improves the globular richness of the blood. It is an active hæmostatic, and stops general oozing of blood and arrests bleeding from the stomach. Binz shows that it is an effective antipyretic, and that it depresses the functions of the brain, causing sleep and ultimately coma. The iodine is eliminated by the kidneys.

Locally applied to the mucous membrane or to an abraded surface it acts as an irritant, having a similar effect to iodine and iodoform.

Therapeutically, iodic acid and the iodates are applied topically to the nares, throat, and auditory canal by subcutaneous injection in the treatment of specific disorders, by the stomach for the relief of maladies of that viscus, for diseases of the glandular system, for bronchitis and asthma, for rheumatic and joint affections, for the effects of subacute inflammation, and to procure the absorption of exudates. For ulcerations of the nasal and pharyngeal mucous membrane Ruhemann advises a mixture of iodic and boric acids—1 to 5 up to 10 parts. As a local application, the same authority advocates the mixture of iodate of sodium and boric acid in the proportion of 1 part of the iodate to 8 or 10 parts of the acid. He finds this combination useful as an antiseptic application in catarrh and other affections of the broncho-pulmonary mucous membrane. For instillation into the eye he advises a solution in water of 1 to 10 or 20.

Iodic acid seems specially valuable as a hæmostatic to restrain bleeding after surgical operations, and to arrest general oozing of blood. It is indicated in *hæmatemesis*. Solutions of iodic acid, 5 per cent up to 20 per cent, are useful in the treatment of *gonorrhœa*, as application to *soft chancre*, for *cervicitis* and other catarrhal affections of the genito-urinary mucous membrane.

In strumous affections, glandular tumors, bronchial asthma, and in the various manifestations of constitutional syphilis the iodates are said to be effective remedies. In these diseases, especially in the syphilitic, iodate of sodium has been administered subcutaneously with much success. In joint tuberculosis, treated heretofore by iodoform injections, iodic acid is said to be preferable, used in the same manner. The pain of the injection may be allayed by the simultaneous use of cocaine. Iodic acid is also recommended to be used by the method of parenchymatous injection in the treatment of tumors, glandular enlargements, and cystic growths.

Authorities referred to:

RUHEMANN, DR. J. *Therapeut. Verwerthbarkeit der Iodsäurer und des iodsauren Natron. Therapeut. Monats.*, *Marz*, April, 1894.

Ether Hydriodicus.—Iodide of ethyl. Ethyl iodide.

This is a colorless, non-inflammable liquid. The odor is peculiar, very powerful and diffusible, and the taste pungent. It is not soluble in water, but dissolves to some extent in alcohol. Its specific gravity is 1·92, and its boiling-point 160° Fahr. Exposed to light and air it assumes a dirty, brownish-yellow color, from the setting free of iodine; hence it should be kept in closely-stoppered bottles in the dark. The dose is five to twenty drops inhaled from a handkerchief, or from the vial containing it, three or more times a day.

PHYSIOLOGICAL ACTIONS.—Although ethyl-iodide might be classified with the other anæsthetic agents, its physiological and therapeutical effects ally it more nearly to the iodides. As an anæsthetic, the action is slow and imperfect. Dr. Lawrence, of Boston, testing the action in his own person, found that a half-hour of inhalation failed to produce even drowsiness. It is said, however, that it induces the anæsthetic state in animals, but further information is needed on this point.

THERAPY.—Ethyl iodide is administered by the broncho-pulmonary mucous membrane. Five to twenty drops are put on a handkerchief and inhaled as may be necessary—every two, three, or four hours, or more or less frequently; or, contained in a small vial, the heat of the hand suffices to disengage the vapor, which can then be inhaled directly. As a means of introducing iodine into the blood, it offers many advantages. When, therefore, it is necessary to induce iodism speedily, as in *syphiloma of the brain or spinal cord*, it is an appropriate remedy. In the spasmodic affections—*the neuroses of the respiratory organs*—as asthma, emphysema, whooping-cough, etc., when accompanied by catarrh of the mucous membrane especially, excellent results are obtained from the inhalations. Dr. Lawrence has found it of exceptional utility in asthma. Good effects may be had from it in *capillary bronchitis*, in *chronic bronchitis*, in *fibroid phthisis*, in *caseous phthisis*, and in local catarrhs of the air-passages.

Iodoformum.—Iodoform.—Iodide of formyl. Small, lemon-yellow, lustrous crystals of the hexagonal system, having a saffron-like and almost insuppressible odor, and an unpleasant, slightly sweetish iodine-like taste. Not perceptibly soluble in water, to which it imparts a slight odor and taste; soluble in 80 parts of alcohol at 15° C. (59° Fahr.) and in 12 parts of boiling alcohol, in 5·2 parts of ether, and in chloroform, benzol, benzin, disulphide of carbon, fixed or volatile oils. It sublimes slightly at ordinary temperatures. (U. S. P.)

Unguentum Iodoformi.—Iodoform ointment. Iodoform, 10 grm.; benzoinated lard, 90 grm.

ACTIONS AND USES. Notwithstanding iodoform contains 97 per cent of iodine, it possesses properties in some respects different from that agent. Discovered by Sérullas in 1822, it was not prescribed until 1836, when Bouchardat used it because of the large quantity of iodine contained in it. In 1853 D'Olleggio brought it forward as a disinfectant and deodorizer; and in 1856 MM. Moretin et Humbert showed it might be substituted for the iodides, because easily absorbed and free from any irritant properties. They also demonstrated that iodoform has anodyne effects, that it induces analgesia of the rectum when applied to it, and that it can be used in the same classes of disease as iodine, and in some neuralgias and painful affections of the bladder and prostate. In 1866 Dr. Eastlake, in the course of a paper on uterine therapeutics, referred to iodoform as a valuable sedative in uterine cases. Dr. Greenhalgh soon after confirmed these observations. The following year, Voelker added some new facts of the same kind. In 1868 Féréol, in a paper read before the Therapeutical Society, gave full details regarding the effects of iodoform on wounds, fully anticipating many of the observations since made on its antiseptic and healing properties.

Little attention had been given to iodoform in Germany, before the investigation made by Binz. Moleschott followed these researches by some important chemical observations, and afterward Mosetig and Mikulicz, of Vienna, and Gussenbauer, of Prague, set forth the remarkable virtues of this substance as an antiseptic dressing. Since these communications appeared, the use of iodoform has received enormous extension, and its popularity has attained to such extravagant proportions, that the wide-spread enthusiasm may be entitled *iodoform-mania.* There can be no question, however, as to its utility. There are, nevertheless, limitations to its employment, imposed by the nature of the substance. It seems desirable, hence, to set forth in a special article its actions and uses, according to the modern conceptions of its powers.

As iodoform contains 97 per cent of iodine, it may be supposed to have analogous properties, but, as the iodine is combined with the radical formyl, another influence enters into the action. Applied in the form of crystals or as a powder, the immediate effect is that of the compound—iodide of formyl—and not that of iodine merely, or of formyl merely; but the latter distinctly modifies the former; hence there is more or less of an anodyne effect. Binz holds that when iodoform is applied to a wound it is dissolved in the fatty bodies of the organism, and that iodine is disengaged to form iodides and iodates. Högyes, on the contrary, maintains that the iodine when set free unites with albumen, and afterward forms salts. Moleschott explains the more energetic action of iodoform by the assumption that it is readily decomposed in the blood, and that the free iodine in its nascent form has more energetic affinities (Rohmer). In what manner soever its mode of action may be explained, the main point, in regard to which all are agreed, is, that the action of iodoform is chiefly due to the iodine. The effects of iodine have already been set forth, and hence no further statements are necessary; but the antiseptic action of iodoform, to which its present applications are chiefly due, requires further exposition. Mikulicz has especially studied the effect of iodoform on decomposing animal substances, and he finds that it prevents change and arrests decomposition when begun. For the purpose of determining its power to prevent putrefaction, he employed Pasteur's liquid, composed of extracts of foods, of malt, of peptones, of alkaline urine, and of bouillon, and blood, and covered this mixed solution with powder and crystals of iodoform. The experiment was varied by adding iodoform in different quantity to solutions having the same composition, and a "control experiment" was employed, to verify the results. It was shown that, in those solutions treated with sufficient iodoform, there was absolutely no development of minute organisms, while in the "control" fluid the germs were abundant and the putrefactive process active. In contact with wounds it has a very prompt and thorough antiseptic action. It promotes union and cicatrization, and at no time are there any heat, redness, swelling, or pain produced by it at the point of application. There is very little secretion from the wound treated by the application of iodoform, and the little observed has rather a serous than a purulent character. When a considerable loss of substance is to be closed by granulations, iodoform does not act so well, it is said, and hence, when the granulations have filled the wound up to the level of the skin, it is better to substitute solutions of nitrate of silver, of acetate of lead, etc.

Notwithstanding iodoform acts in many respects like iodine, there are differences. When the iodides or iodine tincture are given in sufficient doses, among the phenomena of iodism caused are coryza, pharyngeal and laryngeal catarrh, etc., and there ensues very considerable wasting of the tissues in general. On the other hand, when iodoform is given, wasting does not occur, but the body-weight increases, the complexion grows better, and the general condition improves in every way (Rohmer). It can not be affirmed, the author believes, that these beneficial results are constant for all doses of the remedy administered by the stomach, or for all quantity when applied topically. In fact, the first enthusiasm awakened by the discovery of the antiseptic powers of iodoform has been chilled by the untoward results of too lavish application. Not only dusted over the wounded surface, but applied in thick layers, it was soon found that, notwithstanding the slow absorption of iodoform, sufficient entered the blood to produce alarming, serious, even fatal symptoms.

Poisoning by Iodoform.—It is very important to have a clear conception of the mischief which may be thus caused. As iodoform, or some corresponding chemical, will probably continue to have an important place in the antiseptic method of surgical dressings, and as it is also much employed in medical practice, the practitioner should learn to recognize the untoward symptoms. "Eseter, of Trieste," says Louguet, "had a case of death from the iodoform-mania." But many deaths have since followed from the too lavish use of this agent. An idiosyncrasy is observed in some subjects—a special susceptibility to the action of the iodides in general, and to iodoform in especial. It sometimes happens that this idiosyncrasy develops suddenly and without warning, and the toxic symptoms occur at once, death quickly ensuing, although the remedy is suspended (Schede). When the action of iodoform is unfavorable, the symptoms observed have been as follows: 1. Rise of temperature to 104° Fahr., or even higher. 2. In addition to fever, there will be headache, loss of appetite, a rapid pulse, low tension of the vessels, etc., but the symptoms in both classes will quickly disappear if the remedy is discontinued. 3. In this form of iodoform-poisoning, the pulse is quick, reaching even 180, and is feeble; there is much depression of the forces in general, and the condition of the mind is anxious, restless, and melancholic. These symptoms may be caused in some subjects by the first application of iodoform, or may come on after an apparent tolerance has been established. 4. In this group of toxic cases, the same symptoms occur as in the third, viz., high fever, melancholia, etc., but the termination is quickly fatal, although the application of the remedy is stopped. 5. In this group, the symptoms of a profound depression come on, and death speedily occurs in a condition of collapse. In many examples of this kind, it may well be a question whether this accident is not due to the injury of operative procedures. 6. In the more formidable results of iodoform applications, very decided cerebral symptoms have been observed. These have been described by Schede and Küster more especially, and are mentioned by them in connection with the several classes of iodoform-poisoning above referred to. There is, however, a condition of the cerebrum caused by iodoform-poisoning characterized by disordered stomach, high fever, dilated pupils, melancholic depression, stupidity of mind, involuntary evacuations, hallucinations, etc.

Notwithstanding the above-described forms of poisoning have a real existence, it is held by Mundy, Czerny, Küster, and others, that now and then, probably frequently, a septicæmic state, and undiscovered complications, are responsible for the symptoms attributed to iodoform. Making due allowance for such an error, there are still examples of the toxic effects of iodoform; hence the need of proper caution in using it topically.

Treatment of Iodoform Intoxication.—The first step consists in the withdrawal of the application, and every adherent particle should be at once removed. The powers of life should be supported by a judicious use of stimulants, and especially by small doses of the tincture of opium, frequently repeated. Elimination should be promoted by diluents freely administered.

The most important point as regards prophylaxis is to avoid too lavish use of the agent. Schede says that large flesh-wounds should not be filled with iodoform, for then it can be removed only with the scab. Granulating surfaces absorb less, but here the danger of intoxication also exists. Mundy advises that a small quantity only of the powder be dusted over the wound, that the dressings be allowed to remain, and that close sutures and tight bandages be avoided. It appears that caution is needed in the application to the amputated breast, and in all operations involving the peritonæum. As to quantity used, we are guided by the results following lavish use. Three hundred grammes in one case (Beger), 100 to 200 grammes (Henri) in another, have induced poisoning. Death followed the use of 35 to 40 grammes (542 to 620 grains) in a case of operation involving the peritonæum (Küster).

Von Mosetig-Moorhof has employed iodoform in several thousands of surgical cases without a single instance of poisoning, and he attributes this favorable result to the fact that he has not used large quantities of the remedy, that the wound was not subjected to pressure, that the dressings were frequently changed, and that carbolic acid was not used at the same time.

Mode of applying Iodoform.—The simplest mode consists in merely dusting the powder over the surface, wound, or sore, to be acted on. A common tin pepper-box or an insufflator may be utilized for this purpose. Gauze or absorbent cotton may be saturated with an ethereal saturated solution of iodoform and applied according to the methods of Lister. Iodoform and tannin may be applied in any desired proportion after they have been thoroughly triturated together. Iodoform may also be suspended in a mixture with gum—with glycerin and gum-tragacanth. As the odor of this substance is so diffusive and persistent, various means have been resorted to for its removal or modification. The essential oils, the balsams of Peru and tolu, essences of all kinds, menthol, eucalyptol, and thymol, have been employed with varying success ; of these, thymol appears to be the best, for, while it modifies the odor, it less impairs the antiseptic qualities. The mixture of iodoform and thymol may be in any desired proportion. Lindemann advises the following mixture : Iodoform, 1 part ; balsam of Peru, 3 parts ; and vaseline, 8 parts : or iodoform, 1 part ; balsam of Peru, 3 parts ; alcohol, glycerin, or collodion, 12 parts. Recently, pulverized roasted coffee has been shown to be very effective, and this material does not impair the peculiar qualities of iodoform, as many of the disguises now used do.

THERAPY.—In general it may be stated that iodoform is now used in all the *wounds, injuries, diseases,* requiring the action of an antiseptic. *Chancres, ulcers, sloughing* and *phagedenic ulcers, surgical operations,* etc., are especially benefited by its application. It is, above all topical remedies, the most appropriate for *gunshot wounds and injuries* (Mundy). As an antiseptic remedy, it has hardly kept the position originally attained, for it has proved to be less destructive of pathogenic organisms than was supposed during the period of "iodoform mania." Notwithstanding this change in opinion and practice as to its utility in surgical maladies, there has been a steady growth in the appreciation of iodoform in certain diseases of internal organs—in phthisis, hepatic disorders, malarial troubles, etc.

For internal use the dose of iodoform will range between one half a grain to five grains, but the usual dose for an adult, free from any idiosyncrasy as to its action, is two grains, three to six times a day. The most suitable form for administration is the pill, or capsule ; but for some affections, solution in cod-liver oil makes an advantageous preparation.

In chronic *gastric catarrh, gastro-duodenal catarrh,* and when the catarrhal process invades the hepatic and pancreatic ducts, iodoform renders an important service. It checks fermentation, and modifies the catarrhal troubles. The most conspicuous and valuable effects are those produced in catarrhal jaundice—for the remedy not only lessens or removes the morbid action going on in the liver-ducts, but it promotes elimination of the bile acids and pigment contained in the blood. The author has reason to believe that *cirrhosis of the liver*, if the disease is not too far advanced, especially the hypertrophic form, may be arrested by the diligent and persistent use of iodoform in moderate doses. Combination with the salts of manganese—the sulphate chiefly—increases the action, and has been ascertained to be peculiarly effective in gouty subjects.

In *chronic dysentery*, good results have been obtained by iodoform injections (Culbertson). The systemic effects of iodoform are sedative and resolvent (Kirsch), and it has been applied with some success in *phthisis* and in *strumous affections*, but has not proved useful in syphilitic adenitis, although *a priori* it would appear to be clearly indicated. There is much evidence that it is beneficial in the more chronic cases of phthisis, and in those originating in chronic bronchitis and in exudative pleuritis, but examples showing its remarkable power in phthisis florida have also been recently published. In a highly interesting and valuable paper read by Dr. Shingleton Smith before the International Medical Congress, he presents the results obtained from its internal administration by numerous observers in various countries. All forms of phthisis are included, and the results of the practice as reported by such authorities as Prof. Semmola, of Naples; Dr. Colsfeld, of Bremen; Drs. Rummo and Renzi; Dr. Dreschfeld, of Manchester, and Dr. Shingleton Smith, are included in the summary. The therapeutical effects were gain in weight, increase of appetite, lessening of cough and expectoration, lowering of the temperature, and decided diminution, often entire suppression, of sweating. Although, as has been stated, iodoform is not one of the more active germicides, it is very destructive of the *bacillus tuberculosis*, which is remarkably inhibited, and its pullulation prevented. With the internal treatment the topical may be combined, the iodoform in the finest powder, applied by means of an insufflator, or the ethereal solution, inhaled. Also, simultaneously, ethyl iodide can be inhaled, with or without iodoform dissolved in it. Drs. Renzi and Rummo have ascertained that the systemic effects of iodoform are more promptly and powerfully produced when this agent is taken by inhalation than when it is administered by the stomach.

In cases characterized by insufficient oxidation, as the so-called *lithæmia*, *diabetes*, *obesity*, etc., iodoform has proved highly effective in some instances. The amount of testimony in regard to its beneficial action in *diabetes* is quite considerable. The physiological basis for its administration in these maladies consists in its power to increase the conversion of uric acid into urea, and to promote combustion of the nitrogenous material submitted to its action (Testa, Moleschott, Ransome, and others). In cases of obesity, it is highly effective, as compared to the influence of other remedies ; but it should not be forgotten that it causes rapid wasting and anæmia, probably because of the injury done to the red blood-corpuscles (Bozzolo), and hence it must be administered with caution, and in combination with other remedies that will lessen its injurious action on nutrition. Moleschott reports that, in five cases of diabetes, iodoform, in doses of one and a half to three grains, rapidly reduced the quantity of sugar and caused its disappearance in four or five days, although no change in diet had been made. If these extraordinary results are confirmed by the experience of others, it will be impossible to overestimate the value of iodoform as a remedy.

The susceptibility to the toxic action of iodoform varies so greatly that no arbitrary rule of dosage can be properly made. One grain may, if given frequently, cause iodism in some subjects ; on the other hand, three-grain doses may be continued for a long time without any unpleasant effects. Gastric disorder, drowsiness, maniacal excitement, weakness, impaired locomotion, rapid wasting, fever, etc., are symptoms that may arise during the administration of this remedy in moderate doses.

Iodol.—The disagreeable, penetrating, and diffusive odor of iodoform has greatly restricted its use. The attempts made to overcome this inconvenient quality have not been satisfactory, and hence the attention of chemists has been turned in the direction of a substitute, which shall be possessed of the valuable powers of iodoform and free from its unpleasant odor. Iodol has been produced, and may be employed in all of the conditions for which iodoform has hitherto been prescribed. The new medicament is obtained by the action of iodine on certain constituents of animal oil. Its chemical name is *Tetraiodopyrol.* The proportion of iodine is quite large—about 85 parts to 90 by weight—yet not equal to iodoform in this respect, which contains about 96 parts.

Iodol occurs in the form of a grayish-white powder which darkens by exposure to light, is without odor, has very little taste, is readily soluble in alcohol, ether, and chloroform, but is almost insoluble in water. It is, however, quite soluble in the juices of the stomach, for its characteristic actions take place in a short time after its ingestion. The dose for internal administration will range from one fourth of a grain to five grains. It can be given in a wafer, in pill or pellet, or in simple powder.

Although iodol contains somewhat less of iodine than iodoform, it parts with that constituent more readily, whence we conclude that it is quite as effective. Clinical experience confirms this view, for iodol, applied in all the morbid conditions heretofore treated by iodoform, has been found to be quite as useful. It is antiseptic, deodorant, and anæsthetic. Iodine liberated acts on the albuminous elements, and ozone set free oxidizes the compounds of sulphur and phosphorus. It has a feeble escharotic action, whence it forms a thin crust on the surface to which it is applied, and thus acts mechanically in part to retain the medicament in contact with the diseased surface.

The proof that iodol diffuses throughout the organism is conclusive. Applied to a wounded surface, it can presently be detected in the saliva and in the urine, and the same results are obtained when it is administered by the stomach. As compared with iodide of potassium it is much less prompt in action, but more prolonged, and its elimination slower (Pick, Mazzoni).

Experience has now shown that it is never necessary to administer a quantity of iodol that could cause toxic symptoms. Unlike iodoform, no quantity, applied to an open wound, will have a toxic effect (Wolfenden). As a remedy, various modes of application have been proposed—as an impalpable powder, to be dusted on wounds, ulcers, etc., without any addition to it, or any vehicle. A solution in alcohol and glycerin, thus : iodol, 1 part ; alcohol, 16 parts ; glycerin, 34 parts, was proposed originally by Mazzoni, and much used by him as a topical application. An ethereal solution (ʒ j — ℥ j) has some advantage, in that when the ether evaporates, the medicament remains deposited in the minutest subdivision on the affected part. Various forms of applications are now resorted to—for example, iodol pastils, bougies, ointment ; iodol cotton, iodol gauze, etc., corresponding to those made with iodoform.

Without repeating the various therapeutical details, it will suffice to say that iodol can be advantageously substituted for iodoform in the multiform applications of the latter which have had so much professional appreciation within a few years past. That iodol can effectively improve morbid conditions, appropriate for its action, is now admitted by all those who have had experience in its use.

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Loretin.—The chemical designation of this substitute for iodoform is *meta-iodo-ortho-oxyquinoline-ana-sulphonic acid.* Some more manageable title is clearly necessary, and, although trade names are objectionable, this may be adopted as a convenient term sufficiently significant.

Loretin contains iodine in considerable quantity; it has the crystalline structure and the appearance of iodoform, but is entirely free from odor. It is unirritating, and can be freely applied in the form of powder to any open wound without occasioning any distress. It is but slightly soluble in water and alcohol, and not all soluble in ether and fats. It may be dissolved in solutions of alkaline salts, but the chief if not the only mode of application is in the form of powder. It does not cause any erysipelatous or eczematous rash, such as are apt to appear when iodoform is used, and will remove such when formed.

Loretin can be made use of as an antiseptic by merely local application to the surface of wounds in sinuses and cavities, in the treatment of lupus, etc.

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Nosophen.—This is the proprietary designation of *tetra-iodo-phenol-phtalein*, a recent substitute for iodoform. It contains, it is said, 61 per cent of iodine. It occurs as a greenish-yellow powder, is without taste, has no odor, and is entirely insoluble in water. It must, therefore, be prescribed in the form of powder, or suspended in an emulsion, or mixed with ointments. The dose for internal administration ranges from three to six grains, but as it is not irritating nor poisonous it can probably be given in much larger quantity.

As a substitute for iodoform, it is no doubt applicable to the same conditions as that agent, but it contains one third less of iodine, and, although effective as a local anæsthetic and antiseptic, must therefore be somewhat less powerful. It does not cause any local irritation, nor act on the brain, nor produce any of the systemic effects which have followed the free application of iodoform. Nosophen is said to be a powerful antiseptic and germicide, and therefore applicable as a remedy to poisoned wounds, to abscess cavities and sinuses, to the throat and nares in diphtheria, and to chronic catarrhal affections of these parts. It has been employed successfully in otorrhœa. Chancre, gonorrhœa, and specific local diseases are conditions in which it may be highly useful.

Europhen [not euphorin].—By this proprietary designation is *iodo-iso-butyl-ortho-cresol* now known. It has been brought forward as one of the substitutes for iodoform. It is a yellowish, amorphous powder with a saffron-like odor. It is soluble in ether, alcohol, and fats, but not in water. It should contain one fifth to one fourth of iodine, and should not be used in a mixture with the metallic oxides and mercurials with which it is incompatible.

Europhen is employed as a powder undiluted, or mixed with talc or some neutral powder, or in the form of ointment, or dissolved in ether or oil of vaseline. As a substitute for iodoform it is prescribed in affections of the nose, throat, and ear, in diseases of the skin, in venereal diseases, and as an antiseptic in wounds and injuries, and after surgical operations to prevent sepsis and to promote healing. Dr. Szenes, of Budapest, finds it equal to the most approved of the topical remedies, in a series of comparative trials. Dr. Saalfield, of Berlin, has employed it successfully in *intertrigo*, *eczema*, and *ulcers*, in the form of ointment, using 5 to 10 per cent of europhen to the same proportion of lanolin and to 100 parts of talc. Mixed with collodion, it is applied to *bubo*. Neuberger reports on successful trials of europhen in *balanitis*, *herpes*, *soft chancre*, applying it undiluted in the form of powder. Jasinski has had good results with it in the treatment of *local tuberculosis*, and Goldschmidt, of Madeira, in *leprosy*. Ullmann has found it useful in skin diseases in general as a topical application. Chappell, of New York, has employed it with success in the treatment of *ozœna*, and has found it a valuable *hæmostatic*.

Sozoiodol.—The chemical name of this substance is *di-iod-para-phenol-sulphonic* acid. It combines with bases to form salts, of which the combinations with mercury, potassium, and sodium have been used or proposed for use in medical practice. Sozoiodol contains 52 per cent of iodine, and crystallizes in prisms. It is soluble in water, alcohol, and ether.

This preparation has been introduced as a substitute for iodoform, and was first reported on in 1888 by Dr. Fritsche, since which time it has been used with a measure of success, especially in its combination with mercury. But sozoiodol has been applied in the undiluted form, and in solution in water in the treatment of rhinitis and other nasal affections, in otorrhœa, and catarrhal and ulcerative affections of the mouth and throat (Teichmann). It is an excellent antiseptic dressing for wounds and injuries, for venereal sores, and as an injection for gonorrhœa. In venereal diseases it stands in the front rank as a remedy, according to Rosinski. The combination with mercury has been used subcutaneously with much success. In fact, in the whole range of the applications of iodoform for external and internal purposes, sozoiodol may be equally applied.

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Aristol.—*Dithymol-diiodide* is a substitution compound, in which two molecules of hydroxyl have been replaced by two of iodoxyl, and to this product has been given the name *aristol.* It contains 48 per cent of iodine. It is insoluble in water, but dissolves in ether and collodion, and slightly in chloroform.

It is a reddish-brown powder, and has a faint aromatic odor. The powder may be applied undiluted or mixed with other innocuous powder, or made into ointment with lanolin or vaseline.

It has been used chiefly in nasal, aural, and cutaneous maladies. In purulent *otitis media* it has given better results than boric acid, according to Gaevert, Krebs, and Bürkner. In *ulcerations* of the eye, *boils,* and *granulations* it has proved efficacious. For these purposes it is applied in the form of ointment (10 per cent). Chronic rhinitis is also cured by application of the same ointment. In *burns,* according to Haas, it is a valuable antiseptic and analgesic application. According to Heckel, it relieves *sweating of the feet,* and in *psoriasis* it is as effective as chrysarobin, while not staining the neighboring parts. It is also useful in *pityriasis.*

In local venereal affections, as *balanitis, soft chancre, warts,* etc., it has usually acted most favorably.

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Airol.—Under this designation Haegler has recently brought forward a combination of basic gallic acid with bismuth-oxy-iodide. It is *dermatol*, in which iodine replaces OH. It occurs as a greenish-gray voluminous powder, without odor or taste, and permanent in the air. It is slightly soluble in water, and decomposes in acid and alkaline solutions. For topical administration the powder may be dusted over the affected surface, or it may be applied in the form of gauze to 10 to 20 per cent; as an ointment, 10 to 20 per cent; and as a collodion—airol collodion—10 per cent. For internal administration it may be used in powder, in capsule, or in wafer, or it may be suspended in equal parts of glycerine and water. As an injection in tubercular abscesses, Haegler proposes an emulsion of 10 per cent in equal parts of water and glycerine. The dose for use internally ranges from 5 to 15 grains or more. As respects its comparative toxicity, the fatal dose in cats is between 3 and 4 grm. (45 to 60 grains) per kilogramme of body-weight. The toxic dose of iodoform in the same animals is about 1 grm. (15½ grains).

The bacteriological researches of Haegler have demonstrated that airol is about equal to iodoform as a poison of the bacillus of cholera and other pathogenic organisms. As it has the composition of dermatol, and contains besides a considerable proportion of iodine, it should possess a wider range of attributes than this much-vaunted remedy. As a dressing for wounds, it has been used in the same manner and under the same conditions as iodoform. The gauze, ointment, and collodion preparation are thus employed. In chronic otorrhœa and chronic nasal catarrh it is used as powder and ointment successfully.

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MERCURY AND ITS PREPARATIONS.

Hydrargyrum.—Mercury. *Mercure*, Fr.; *Quecksilber*, Ger. A silver-white metal, liquid at common temperatures, and having the specific gravity 13·5.

Preparations.—*Emplastrum Ammoniaci cum Hydrargyro.*—Plaster of ammoniac with mercury. Composition: Ammoniac, 720 grm.; mercury, 180 grm.; oleate of mercury, 8 grm.; diluted acetic acid, 1,000 c. c.; and lead plaster, q. s. to make 1,000 grm.

Emplastrum Hydrargyri.—Mercurial plaster. Composition: Mercury, 300 grm.; oleate of mercury, 12 grm.; lead plaster, q. s. to make 1,000 grm.

Hydrargyrum cum Creta.—Mercury with chalk. Composition: Mercury, 38 grm.; prepared chalk, 57 grm.; clarified honey, 10 grm. A gray powder partly dissipated by heat. When a small portion is treated with dilute acetic acid in excess, it is partly dissolved, nothing remaining but mercury in the form of minute globules. Dose, gr. ss—gr. x. Eight grains contain three grains of mercury.

Massa Hydrargyri.—Pills of mercury. Blue mass. Composition: Mercury, confection of rose, and powdered licorice-root. Three grains contain one grain of metallic mercury. Dose, gr. ss—gr. xv.

Unguentum Hydrargyri. — Mercurial ointment. Composition: Mercury, lard, suet, and oleate of mercury.

Hydrargyri Oxidum Flavum.—Yellow mercuric oxide. An orange-yellow powder, which, on being heated, assumes a red color; then, if the heat be increased, it evolves oxygen, and finally the mercury evaporates without residue.

Unguentum Hydrargyri Oxidi Flavi.—Ointment of yellow mercuric oxide. Composition: Yellow oxide, 10 grm.; ointment, 90 grm.

Oleatum Hydrargyri.—Oleate of mercury. Yellow oxide, 10 parts; oleic acid, 90 parts.

Hydrargyri Oxidum Rubrum.—Red mercuric oxide. Red precipitate. An orange-red powder, entirely soluble in muriatic acid. When heated it does not emit reddish fumes, but gives off oxygen, while the mercury either runs into globules or is wholly dissipated.

Unguentum Hydrargyri Oxidi Rubri.—Ointment of red mercuric oxide. Composition: Red oxide, 10 grm.; ointment, 90 grm.

Hydrargyri Subsulphas Flavus.—Yellow mercuric subsulphate. Turpeth mineral. A lemon-yellow powder, sparingly soluble in water. It is entirely dissipated by heat, sulphurous acid being evolved, and globules of mercury sublimed. Dose, gr. ij—gr. v, as an emetic.

Hydrargyri Chloridum Corrosivum.—Corrosive mercuric chloride. Corrosive sublimate. In colorless crystals or crystalline masses, which are fusible, and sublime without residue. It is entirely soluble in water (1 in 16), alcohol (1 in 3), and in 4 parts of ether. Lime-water causes a yellowish precipitate and ammonia a white one, from its solution. Dose, gr. $\frac{1}{30}$—gr. $\frac{1}{10}$.

Hydrargyri Chloridum Mite.—Mild mercurous chloride. Calomel. A white powder, wholly volatilized by heat, and insoluble in water, alcohol, and ether. With solution of potassa it yields a black precipitate of oxide of mercury, which is reduced by heat to the metallic state. Distilled water, after having been boiled with it, yields no precipitate with ammonia or nitrate of silver. Dose, gr. $\frac{1}{20}$—gr. x.

Pilulæ Antimonii Compositæ.—Compound pills of antimony. Plummer's pills. Composition: Sulphurated antimony, calomel, and guaiac. Each pill contains one-half grain each of antimony and calomel, and one grain of guaiac.

Hydrargyri Cyanidum.—Mercuric cyanide. In white prismatic crystals, soluble in 12·8 parts of water. When muriatic acid is added to the solution, hydrocyanic acid is evolved, made evident by its odor, and bichloride of mercury is left, which is entirely volatilized by heat. Dose, gr. $\frac{1}{20}$—gr. $\frac{1}{6}$.

Hydrargyrum Ammoniatum.—Ammoniated mercury. White precipitate. In white powder or pulverulent masses, decomposed and entirely dissipated by a strong heat, insoluble in water and alcohol, but dissolved without effervescence by muriatic acid.

Unguentum Hydrargyri Ammoniati.—Ointment of ammoniated mercury. Composition: Ammoniated mercury, 10 grm.; benzoinated lard, 90 grm.

Hydrargyri Iodidum Flavum.—Yellow mercurous iodide. A greenish-yellow powder, which becomes red when heated. It is insoluble in water and alcohol. Dose, gr. $\frac{1}{6}$—gr. j.

Hydrargyri Iodidum Rubrum.—Red mercuric iodide. A red powder, which becomes yellow when heated, and red again when cold. It is wholly volatilized by heat, condensing in scales, which are at first yellow, but afterward become red. It is insoluble in water, but is dissolved by boiling alcohol, and by solutions of iodide of potassium and chloride of sodium. Dose, $\frac{1}{30}$—gr. $\frac{1}{16}$.

Unguentum Hydrargyri Iodidi Rubri.—Ointment of red mercuric iodide. Composition: Red iodide, 5 parts; ointment, 95 parts.

Hydrargyri Sulphidum Rubrum.—Red sulphuret of mercury. Cinnabar. In brilliant crystalline masses, of a deep-red color and fibrous texture. It is entirely volatilized by heat. When heated with potassa it yields globules of mercury. It is not soluble in either nitric or muriatic acid, but is dissolved by a mixture of the two. Acetic acid which has been digested with it does not yield a precipitate with iodide of potassium.

Liquor Hydrargyri Nitratis.—Solution of mercuric nitrate. Mercury dissolved in nitric acid. Acid nitrate of mercury. "A transparent, nearly colorless, acid liquid, having the specific gravity 2·100. It is not precipitated by the addition of distilled water; and the diluted solution affords, with potassa, a dirty-yellow precipitate, and with iodide of potassium a bright-red one, soluble in an excess of the precipitant. When dropped on a bright surface of copper, the diluted solution instantly deposits a coating of mercury."

Unguentum Hydrargyri Nitratis.—Ointment of mercuric nitrate. Citrine ointment.

Unguentum Hydrargyri Nitratis cum ol. Morhuæ.—Not official. In the preparation of this ointment there are two steps: Solution No. 1 is composed of cod-liver oil, 13 oz.; lard, 3 oz. Solution No. 2 is made by dissolving 1½ oz. of mercury in 3½ ozs. of nitric acid. By a heat of 200° Fahr., the lard is dissolved in the oil. Both solutions are slowly mixed by stirring until thoroughly incorporated.

Antagonists and Incompatibles.—Corrosive sublimate is incompatible with alkalies and their carbonates, lime-water, tartar emetic, nitrate of silver, acetate of lead, albumen, iodide of potassium, soaps, various vegetable infusions, including cinchona. Calomel is incompatible with the alkalies and alkaline earths and alkaline carbonates, with iron, lead, and copper. It should not be given in the same prescription with iodine (forms red iodide), and nitro-muriatic acid should not be prescribed in conjunction with it, lest corrosive sublimate be formed. There is little doubt, also, that calomel is converted into corrosive sublimate by the chlorides of sodium, potassium, and ammonium. The acids and acidulous salts are incompatible with hydrargyrum cum creta.

In cases of poisoning by mercurial salts, especially corrosive sublimate, albumen, white of egg, wheaten flour, milk, etc., may be administered. The white of one egg is considered sufficient for four grains of corrosive sublimate. An excess of albumen may redissolve the compound. Emesis should be promptly induced.

Synergists.—Depressing medicines, antimony, alkalies, especially alkaline chlorides, etc., promote the physiological activity of mercurials.

Physiological Actions.—Metallic mercury in direct contact with the skin or mucous membrane is without action. Swallowed, it is purgative by virtue of its weight. If retained in the intestinal canal, it will form soluble combinations, enter the blood, and produce characteristic systemic effects. Similarly prolonged contact with the skin will be followed by the constitutional action of the drug. Injected into the veins, it will be arrested in the capillaries, producing the usual phenomena of capillary embolism. Mercury gives off vapors at the ordinary temperatures, which have, in notable instances, caused serious constitutional symptoms. As used in the mechanical arts, by gilders and others, the fumes of mercury cause wasting, ptyalism, necrosis of bones, trembling, impaired intellect, and in women, abortion. Without producing such obvious effects as ptyalism, mercurial cachexia, eczema, and disease of the bones, obscure nervous phenomena may result. Among these may be enumerated headache, loss of memory, trembling, defects of co-ordination, disorders of sensation, convulsions, and dementia.

Mercury is readily absorbed—as a vapor by the pulmonary mucous membrane, when applied to the integument, or when taken into the alimentary canal. It probably exists in the blood as an albuminate.

Recent experiments (Wilbouchewitch, Keyes) have shown that mercury, as iron, manganese, and other metals, has the power to increase the number of red corpuscles, and to improve the quality of the blood, provided it is exhibited in small quantities, not often repeated. It has long been known (Liegeois) that this result followed the use of corrosive chloride in syphilis. Schlesinger has recently gone over the question anew with the same result, but he doubts whether the effects are really tonic. It remains true, however, that any considerable quantity of mercury, administered a sufficient time, will affect the quality and composition of the blood; the red globules are diminished in number; the fibrin loses its plasticity; the proportion of water is increased, and various effete materials, whose nature is unknown, accumulate. Mercury is deposited in all the textures, interferes with the normal nutritive processes, and is found in all the secretions and excretions. A marked degree of anæmia, loss of flesh, muscular weakness, intractable ulcerations of the skin, loss of hair, eczema, a foul breath, diarrhœa, the stools being very fetid, are the characteristic symptoms of the action of mercury on the solids and fluids of the body.

This metal has a selective action on the lymphatic glandular system, and notably on the salivary glands and pancreas. Among the earlier symptoms of the action of mercury are an increase of the salivary secretion, an alteration of its quality, fetor of the breath, swollen tongue, soreness of the teeth, a blue or dark slate-colored line along the margin of the teeth, sponginess of the gums, swelling of the parotid, sublingual, and submaxillary glands, aching of the jaws and teeth, with general muscular soreness and aching of the limbs, and some elevation of temperature. To this state are applied the terms *acute mercurialismus*, *ptyalism*, in common language, *salivation*. Mercury certainly stimulates the pancreas; this gland, like the salivary glands, becomes swollen, congested, and pours out an abundant secretion which, however, is not a normal but a pathological secretion. There is little doubt also that mercury increases the action of the intestinal glandular appendages, and thus acts as a purgative. It not only increases the activity of these glands, but is itself in part excreted by them. The products of the increased waste of the tissues caused by mercury are also largely eliminated by the intestinal glands.

Although calomel had been long known to act well in some cases of dropsy, especially when associated with squill and other diuretics, the untoward effects not infrequently observed—since known to be examples of renal dropsy with albuminuria—lessened confidence in its utility, and increased the distrust felt of all mercurials, against which a general revolt was rising. The experimental method and the growth of a truer scientific spirit have combined to revive confidence in the use of mercury, and hence the former belief in its diuretic power has been subjected to clinical trials by such observers as Leyden [*Therap.*

Monatshefte of April, 1887], Rosenheim and Fürbringer [*Ibid.*], Weinstein [*Wiener med. Blatte*, 1887], and Jendrassik [*Deutsch. Archiv f. klin. Med.*, April, 1886], with many others.

These recent experiences confirm the belief in the diuretic action of calomel, formerly an article of medical faith. The quantity required to act on the kidneys, and the conditions under which this physiological property is manifested, have been the subject of careful inquiry, and conclusions of a practical character have been reached. It is generally held by those most familiar with its diuretic action that the dose of three grains three times a day is about the quantity usually required. Experience has shown that more than this will cause diarrhœa or more serious trouble of the gastro-intestinal mucous membrane, and the danger of acute mercurialismus rises with the quantity administered.

Although the diuretic property is an endowment of calomel *per se*, and is exerted under suitable conditions, it is quite certain that in the renal dropsies there is far more danger of ptyalism, and the explanation of this is afforded by the changes in the composition of the blood due to albuminuria. To prevent ptyalism, the use of potassium chlorate is practiced from the outset, and diarrhœa is prevented or restrained by the conjoint administration of opium. Such are the prophylactic measures suggested by some of those advocating the diuretic property of calomel, and who are mentioned above. Although anticipating somewhat, the author has to say that the combination of belladonna extract with the calomel has an excellent effect both to prevent diarrhœa and ptyalism, and is more efficient in the latter, and is active enough, usually, to keep the former in due restraint.

An explanation of the diuretic action of calomel may be sought for in several directions. It is well known that purgatives often increase renal action by an influence reflex in mechanism. From the intestinal mucous membrane an impression is radiated by means of the solar plexus over the nerves of the renal system. If, however, the blood pressure is reduced by profuse watery evacuations, the kidneys do not act as strongly. It would seem, on first view, that the compound jalap powder acts in a manner opposed to the explanation just given, for it produces watery evacuations and also diuresis, but the renal action is a consequence of the bitartrate.

The misconception of the action of mercurials on the liver has prevailed chiefly because of the peculiar evacuations produced by it. The true explanation of the nature of these stools has been given above, but the subject should not be dismissed without further reference to the experimental work devoted to the elucidation of this subject within the past few years. The experiments of Röhrig, Rutherford, and Scott on animals, and the observations of Westphalen and Ranke in cases of biliary fistulæ in man, have thrown a flood of light on the actions of mercurials, and there seems to be no longer any reason to doubt the accuracy of the conclusions reached. It has been shown that calomel lessens the physiological activity of the liver, and consequently diminishes the production of bile. Instead of stimulating the liver, or acting as a cholagogue, calomel must be regarded as a sedative, and as having the power to allay an irritable state of the liver. Oddly enough, this fact harmonizes in the most satisfactory way with clinical experience, for calomel has always been regarded as useful in the highest degree in those cases of "biliousness," characterized by a surplusage of bile, due to an over-acting liver. Under such circumstances an active cholagogue, stimulating the productive capacity of the organ, would only increase the existing complications.

While the sedative action of mercurials, including calomel and its congeners, on the hepatic functions has been established, by the same kind of investigation it has demonstrated that the corrosive chloride is to some extent a cholagogue increasing the production of bile (Rutherford), and as its stimulating action must include the glycogenic function as well, it may be supposed that its tonic and reconstituent power is thus produced. If we add to the cholagogue properties of mercury, which it possesses in common with resinous purgatives, the action on the pancreas and the increased elimination of the products of waste by the intestinal glands, we obtain a satisfactory explanation of those powers which have, under the term *alterative*, been heretofore ascribed to mercury.

Mercury is eliminated by the salivary and the intestinal glands, by the liver, but chiefly by the kidneys. As a result of the changes in the composition of the blood, and of the direct action of the metal on the renal epithelium, albuminuria is one of the symptoms present in cases of mercurialism. Without the use of special means to render it soluble, and despite the use of such means, sometimes mercury remains permanently in the organism. When extremely severe cases of salivation were not uncommon, permanent damage to the osseous structures often occurred, and globules of mercury could be shaken out of the dried bones of such subjects. Happily, nowadays, such cases do not occur. The moderate use of mercury, short of ptyalism, does not appear to affect the human system injuriously.

There are but few chronic affections of the nervous system not imitated in the multiform examples of chronic mercurialism. From the most trifling affections of sensibility and motility up to complete anæsthesia and paralysis, there are numerous gradations in the importance of the lesions. From slight headache and impaired memory up to complete dementia there are, also, immense variations in the gravity of the mental and cerebral symptoms. The most frequently encountered nervous lesion is "trembling," and to this symptom more attention has been given, from the period of Küssmaul's elaborate essay, up to the present.

It has been supposed, hitherto, that the mercurial trembling is accompanied by muscular paresis, but recent observations have shown that this view of their absolute association is incorrect, the two conditions not necessarily being present together (Letulle). The paresis, which is usually more pronounced in the upper extremities, is not attended by trophic changes, as a consequence—the muscles flaccid, but not degenerating. At the beginning of the structural changes the reflexes are rather heightened, but, as the paresis increases, they decline. The electrical reactions are normal in character, but a quantitative decline sometimes occurs. Disorders of sensibility accompany the motor derangements. A characteristic of the disordered sensibility is its localization to defined areas, the whole member not being affected, and the restriction to the extremities, the trunk remaining unaffected. The actual disorders of sensibility consist in lessening the tactile and pain sense, and in an aberration of the sense of temperature; but rarely is there a complete abolition of the sensibility, and usually the changes are rather of a fugitive character. Corresponding disorders of function appear in the organs of special sense, and are due to atrophic degeneration of the nerve-elements. Huskiness of voice, even complete aphonia, have been the result of paralysis of the laryngeal muscles.

From the point of view of pathology, the motorial and sensory disturbances caused by mercury are due to a direct action on the protoplasm of a destructive character, and in respect to the nerve-elements (Hallopeau) the initial changes occur in the most highly specialized. Like arsenic, lead, and other metals, mercury sets up a fatty degeneration of the gland-cells.

EFFECTS OF THE DIFFERENT PREPARATIONS.—Hydrargyrum cum creta, calomel, and blue-pill are very similar in action. Calomel, being insoluble, probably escapes solution and combination in the stomach, and is decomposed by the alkaline contents of the small intestine, the oxide of mercury being precipitated. It follows, from this reaction, that the effects of blue-pill and calomel must be similar, and in practice it is found that they correspond closely therapeutically. Salivation more frequently results from the use of blue-pill than from the other mercurials; and calomel comes next in point of activity in this respect.

The corrosive chloride, the red iodide, and the cyanide, are powerful irritant and corrosive poisons. When a poisonous dose of corrosive sublimate has been swallowed, the mucous membrane of the mouth has usually, but not invariably, a whitish, glazed appearance, as if it had been washed over with a strong solution of the nitrate of silver. A sense of constriction of the throat and a strong styptic and metallic taste are experienced. The toxic symptoms follow in a few minutes the ingestion of the poison. Usually, violent pain is felt in the abdomen, but this is not invariable. Vomiting follows, and the vomited matters consist at first of the contents of the stomach, and afterward of mucus streaked with blood. There are usually purging, tenesmus, intestinal cramp, and not unfrequently dysenteric discharges.

These evidences of violent gastro-intestinal irritation are accompanied by small, weak pulse, coldness of the surface—but sometimes by a swollen and flushed face—sighing respiration, syncope, insensibility, or convulsions. If the patient survive a few days, ptyalism may occur.

The following are the symptoms of chronic poisoning stated in the most concrete form: abdominal pains; nausea; vomiting; dysenteric diarrhœa; general weakness, trembling, or paralysis, and other nervous affections; ptyalism; fever; emaciation, etc. There sometimes occurs a blue line along the margin of the teeth, not unlike that produced by lead. Suppression of urine is a not infrequent symptom in acute poisoning, and albuminuria is very often present in cases of chronic mercurialismus.

The corrosive chloride and the red iodide of mercury are the most powerful antiseptics and germicides now available. Their germicide powers have been made the subject of investigation in the only way that such a question can be determined—by ascertaining the degree and character of their effects on cultures of the pathogenic organisms. To Miguel, De la Croix, Bucholtz, and others in Europe, and to Sternberg and Welch in this country, we owe the very accurate knowledge now possessed of the character and limits of the germicide power. Any difference that exists between the chloride and iodide, in respect to their power to destroy disease-germs, is in favor of the latter (Miguel). An effective germicide is destructive not only of the organism but of its ova. Experience has demonstrated that the germ—the microbe—may be killed and yet the ova resist the action of the germicide and hence pullulation goes on as actively as before. No antiseptic is entitled to be so designated unless its power is equal to the destruction of the organism and of its ova also.

Therapy.—The acute glandular affections of throat and neck—*tonsillitis, parotitis, inflammation of the submaxillary and sublingual glands*—are often speedily removed by mercurial preparations. The one twentieth of a grain of calomel, or the one fifth of mercury with chalk, may be given every two hours, or one minim of the following solution may be administered at the same interval: ℞ Hydrarg. chlor. corrosiv., gr. j; aquæ, ʒ j. M. Sig.: Dose, ♏ j. Chronic affections of these organs are not benefited by these remedies, and the so-called scrofulous diseases of the cervical glands are made worse by them.

Corrosive sublimate is an effective remedy in *gastric ulcer*. The thirtieth to the sixtieth of a grain, three times a day before meals, is a proper quantity and occasion for this purpose. Certain kinds of *vomiting* are quickly cured by small doses of calomel. The *vomiting of children*, caused by indigestible food or by constipation, or by these causes combined, is often speedily relieved by one-twelfth-of-a-grain doses of calomel every half-hour or hour, dropped on the tongue. This remedy is the more efficacious when such vomiting is accompanied by great heat of head, restlessness, and fever. The vomiting of *cholera infantum* is often stopped by the same means.

It has long been held that mercurials are specially indicated in that *catarrhal state of the intestinal mucous membrane and of the hepatic duct*, manifested by nausea, anorexia, tympanites, whitish or clay-colored stools, and jaundice. The use of mercury in these cases is predicated on its supposed power to promote the flow of bile. It is true, no doubt, that calomel and blue-pill will remove these symptoms, but such mild salines as phosphate of soda, sulphate of magnesia, tartrate of soda and potassa. etc., will usually succeed quite as well and without detriment to the patient. The *diarrhœa and dysentery of infants* (ileo-colitis) is frequently treated by minute doses of calomel or hydrargyrum cum creta. When there are much straining and bloody mucus, it is said that small doses of corrosive chloride prove very effective, but the author is convinced that mercurials are much abused in these affections. Children are quickly poisoned by mercurials, although they are not easily salivated. The spinach-colored stools which so frequently occur in the summer complaint of children, and which are, by ignorant practitioners, supposed to be produced by the mercury administered, really belong to cases of ileo-colitis, and may, by their persistence and profuseness, signify an increased irritation of the intestinal mucous membrane due to the remedies given. While the author believes that other medicines are more useful than mercury in the ileo-colitis of children, he is convinced of the utility of minute doses of calomel (one twentieth to one twelfth of a grain every half-hour) when there is much irritability of the stomach. Mercurials are contraindicated in the *diarrhœa and dysentery* of adults, as a rule.

It was formerly an article of faith to hold that mercury was a sovereign remedy in *hepatic disorders*. The state known as *biliousness*, characterized by a yellowish-coated tongue, yellow conjunctivæ, muddy skin, nausea, constipation, may be removed by a mercurial purge when these symptoms are due to catarrh of the duodenum, excesses of the table, sudden checking of the perspiration, etc. The blue-pill, or mercury with chalk, or calomel, succeeds in these cases by removing offending substances from the intestinal canal, by relieving a catarrhal state of the mucous membrane, or by causing elimination of waste products by the intestinal glandular apparatus. Less objectionable agents may be employed with equal success.

The experience of the India medical officers has shown conclusively that mercurials are harmful in *acute hepatitis, hepatic abscess, jaundice from gall-stones, acute yellow atrophy*, etc. As these affections are very rife in India, an experience which has led to such conclusions should be heeded. There is no evidence to show that mercurials render the least service in *cirrhosis*.

Calomel is a very efficient *purgative*. It will be retained when other purgatives are rejected by the stomach; it is free from taste, and may therefore be given easily to children. When it operates, nausea and tormina may be experienced. One grain of calomel at night will act in the morning, and not unfrequently a half-grain will give satisfactory results. A full purgative dose of calomel (five grains) is an excellent *vermifuge* for the *lumbricoid worms.* It may be given with santonine. At the onset of *acute febrile diseases,* calomel is a useful purgative; it hastens waste, and causes the elimination of the products by the intestine.

Mercurials were formerly much esteemed in the treatment of *acute inflammation,* especially of serous membranes. As calomel—the mercurial preparation usually employed—was combined with opium, it was not known to which remedy the good results were due, but the mercurial was considered to have the larger share of merit. It is now admitted that opium was the effective agent. An apparent exception to this statement exists in the case of *iritis,* a disease in which the good effects of mercury are most conspicuous; but iritis, probably, is always of syphilitic origin, and, in *syphilitic inflammation of serous membranes,* it is not disputed that mercurials are extremely efficacious. In these days, however, although opium is considered indispensable in peritonitis, pleuritis, pericarditis, etc., mercury is no longer combined with it. No longer is it considered necessary to "touch the gums" in order to cure a serous inflammation, and only the most prejudiced and benighted practitioners insist in the use of mercurials in these inflammatory affections.

Large doses of calomel—five grains every four hours—are said to be very efficacious in *true croup or membranous laryngitis.* It is claimed that it allays spasm and checks the formation of the false membrane. The author is skeptical in regard to the utility of calomel in this affection. There is, however, no doubt as to the value of the yellow subsulphate (turpeth mineral) as an emetic in this disease. If given early, it is the doubtful statement of Dr. Fordyce Barker, of New York, that a fatal result will most certainly be averted. From two to four grains of the subsulphate may be given as an emetic for a child with croup. Serious results might be produced by this dose if emesis did not so promptly follow. The powder comes up with the contents of the stomach, in from five to fifteen minutes after being swallowed. But little depression follows the emesis produced by turpeth mineral, in which respect it has a decided advantage over sulphate of copper, tartar-emetic, and even ipecacuanha. As it is insoluble, this remedy should be rubbed up with sugar and placed on the base ot the tongue.

Corrosive sublimate has lately been used with very distinct advantage in the treatment of *diphtheria.* Its remarkable germicide property is the motive for its employment, and clinical experience strongly supports the results of experiment. The dose administered in the treatment of diphtheria will range, according to the age of the subject, from $\frac{1}{100}$ grain to $\frac{1}{15}$ grain every four or six hours.

Liebermeister, following the lead of Traube, Wunderlich, and others, has obtained surprising results from the use of calomel in *typhoid fever*. By our German *confrères* this treatment is called the *specific treatment* of abdominal typhus. It consists in the administration of ten grains of calomel in a single dose the first day, and eight grains a day for three or four days thereafter. It is a curious fact that these large doses of calomel have an antipyretic effect. According to the statistics of Liebermeister, the "specific" calomel treatment shortens the duration and lessens the mortality from typhoid fever, as compared with the non-specific, expectant, or other plans of medication.

Calomel is one of the numerous remedies used in the treatment of *cholera Asiatica*. Two methods are pursued: large doses at considerable intervals; small doses frequently repeated. The latter method is nowadays much more usually practiced. In consists in giving every fifteen minutes, half-hour, or hour, the one sixth, one half, or one grain of calomel, combined with opium, chalk, piperine, etc. The author, who has had considerable experience in the treatment of cholera, can not express any degree of confidence in the efficacy of this treatment. Large doses (a scruple to a drachm) sometimes appear to arrest vomiting when other means fail, but there is danger of excessive ptyalism when reaction sets in.

All the salts of mercury possess the diuretic property to some extent, but the chlorides, especially calomel, are the most efficient. In *cardiac dropsy* calomel becomes one of the most important means of relief. When the action of the heart is rapid and the tension of the vessels high, and the breathing is embarrassed by the accumulating fluid, the exhibition of a daily dose of two or three grains each will often procure considerable discharge of urinary water, and by unloading the portal circulation will in this way also rid the system of water. It has long been known that calomel has diuretic effect, but it was prescribed in fractional doses with squill and digitalis. Graves, of Dublin, and G. B. Wood, of Philadelphia, and before them Rush, were advocates of this practice, but the use of larger doses daily is a distinctly modern method. The experimental evidence showing the effect of mercury on the kidneys is conclusive. Jendrassik was probably the first to demonstrate the action; afterward Cohnstein showed that the hypodermatic injection of a solution of mercury increases diuresis, probably by an action on the epithelium, and by raising the pressure in the renal vessels, the mercury itself appearing in the urine. Dr. Pal gives a summary of the observations made experimentally, which show that mercury raises the blood pressure in the renal system, that it acts on the renal epithelium, and may even cause nephritis.

other purgatives are rejected by the stomach; it is free from taste, and may therefore be given easily to children. When it operates, nausea and tormina may be experienced. One grain of calomel at night will act in the morning, and not unfrequently a half-grain will give satisfactory results. A full purgative dose of calomel (five grains) is an excellent *vermifuge* for the *lumbricoid worms*. It may be given with santonine. At the onset of *acute febrile diseases*, calomel is a useful purgative; it hastens waste, and causes the elimination of the products by the intestine.

Mercurials were formerly much esteemed in the treatment of *acute inflammation*, especially of serous membranes. As calomel—the mercurial preparation usually employed—was combined with opium, it was not known to which remedy the good results were due, but the mercurial was considered to have the larger share of merit. It is now admitted that opium was the effective agent. An apparent exception to this statement exists in the case of *iritis*, a disease in which the good effects of mercury are most conspicuous; but iritis, probably, is always of syphilitic origin, and, in *syphilitic inflammation of serous membranes*, it is not disputed that mercurials are extremely efficacious. In these days, however, although opium is considered indispensable in peritonitis, pleuritis, pericarditis, etc., mercury is no longer combined with it. No longer is it considered necessary to "touch the gums" in order to cure a serous inflammation, and only the most prejudiced and benighted practitioners insist in the use of mercurials in these inflammatory affections.

Large doses of calomel—five grains every four hours—are said to be very efficacious in *true croup or membranous laryngitis*. It is claimed that it allays spasm and checks the formation of the false membrane. The author is skeptical in regard to the utility of calomel in this affection. There is, however, no doubt as to the value of the yellow subsulphate (turpeth mineral) as an emetic in this disease. If given early, it is the doubtful statement of Dr. Fordyce Barker, of New York, that a fatal result will most certainly be averted. From two to four grains of the subsulphate may be given as an emetic for a child with croup. Serious results might be produced by this dose if emesis did not so promptly follow. The powder comes up with the contents of the stomach, in from five to fifteen minutes after being swallowed. But little depression follows the emesis produced by turpeth mineral, in which respect it has a decided advantage over sulphate of copper, tartar-emetic, and even ipecacuanha. As it is insoluble, this remedy should be rubbed up with sugar and placed on the base of the tongue.

Corrosive sublimate has lately been used with very distinct advantage in the treatment of *diphtheria*. Its remarkable germicide property is the motive for its employment, and clinical experience strongly supports the results of experiment. The dose administered in the treatment of diphtheria will range, according to the age of the subject, from $\frac{1}{100}$ grain to $\frac{1}{15}$ grain every four or six hours.

Liebermeister, following the lead of Traube, Wunderlich, and others, has obtained surprising results from the use of calomel in *typhoid fever*. By our German *confrères* this treatment is called the *specific treatment* of abdominal typhus. It consists in the administration of ten grains of calomel in a single dose the first day, and eight grains a day for three or four days thereafter. It is a curious fact that these large doses of calomel have an antipyretic effect. According to the statistics of Liebermeister, the "specific" calomel treatment shortens the duration and lessens the mortality from typhoid fever, as compared with the non-specific, expectant, or other plans of medication.

Calomel is one of the numerous remedies used in the treatment of *cholera Asiatica*. Two methods are pursued: large doses at considerable intervals; small doses frequently repeated. The latter method is nowadays much more usually practiced. In consists in giving every fifteen minutes, half-hour, or hour, the one sixth, one half, or one grain of calomel, combined with opium, chalk, piperine, etc. The author, who has had considerable experience in the treatment of cholera, can not express any degree of confidence in the efficacy of this treatment. Large doses (a scruple to a drachm) sometimes appear to arrest vomiting when other means fail, but there is danger of excessive ptyalism when reaction sets in.

All the salts of mercury possess the diuretic property to some extent, but the chlorides, especially calomel, are the most efficient. In *cardiac dropsy* calomel becomes one of the most important means of relief. When the action of the heart is rapid and the tension of the vessels high, and the breathing is embarrassed by the accumulating fluid, the exhibition of a daily dose of two or three grains each will often procure considerable discharge of urinary water, and by unloading the portal circulation will in this way also rid the system of water. It has long been known that calomel has diuretic effect, but it was prescribed in fractional doses with squill and digitalis. Graves, of Dublin, and G. B. Wood, of Philadelphia, and before them Rush, were advocates of this practice, but the use of larger doses daily is a distinctly modern method. The experimental evidence showing the effect of mercury on the kidneys is conclusive. Jendrassik was probably the first to demonstrate the action; afterward Cohnstein showed that the hypodermatic injection of a solution of mercury increases diuresis, probably by an action on the epithelium, and by raising the pressure in the renal vessels, the mercury itself appearing in the urine. Dr. Pal gives a summary of the observations made experimentally, which show that mercury raises the blood pressure in the renal system, that it acts on the renal epithelium, and may even cause nephritis.

In these physiological actions we have an adequate explanation of the nature of the curative power of mercury in dropsy. As regards its action in the cardiac form of dropsy, the effect may be in part referred to its influence on the hepatic secretions—to the formation of urea and the conversion of uric acid; to the mechanical and reflex results of depletion of the portal circulation. The effect on the heart is shown in a diminution of its beats and in a lowering of the general vascular tension; the renal effect consists in an increase of the urinary secretion through stimulation of the tubular epithelium, and rise of tension in the kidney vessels.

The good effects of mercurials, of calomel especially, in dropsy are not confined to the cardiac form. It is often highly useful in dropsy strictly of renal origin. In the acute form of tubular nephritis, with desquamating epithelium and scanty urine, a purgative dose of calomel may have a prompt and powerful effect in relieving the head symptoms and starting up again renal excretion.

The preparations of mercury must be used with caution in cardiac dropsy when coincident with renal disease, or in nephritis when a special susceptibility to the mercurial action exists. Very severe ptyalism has occurred from the exhibition of even small doses of calomel in cases of renal albuminuria. While caution is necessary, it is also true that mercury is often most useful in *renal dropsy*. The dose of calomel as above given is rather under than above the quantity now considered necessary. From three to six grains a day in single doses may be regarded as the most efficient mode of administration.

The most important application of mercury therapeutically is in the treatment of *syphilis*. The reaction which set in against its use a few years ago has certainly led to important modifications in the mode and quantity in which mercury should be given; but the fact has been conclusively established that mercury in a certain sense is antidotal to syphilis. As mercury exerts a germicide action on the organism of syphilis, this agent should be used with the earliest manifestations of the specific character of the infecting sore. Mercury is not indicated in chancroid, or non-infecting chancre, and should not be used. If the chancre have the characteristic quality of the infecting sore, small doses of one of the mercurial preparations should be begun and continued steadily until all induration has disappeared. The important point is, not to induce ptyalism. It is now conceded that the danger of a relapse will be very much lessened by continuing the mercurial treatment for some time—for several months—after local manifestations have ceased. The ill effects of a mercurial course may be prevented by the use of small doses, by careful attention to hygiene, and by lessening the dose, or discontinuing the remedy entirely, whenever soreness of the jaws can be developed by smartly closing the teeth. By the adoption of these precautions, a mercurial course may be continued without important interruptions until the period of incubation has entirely passed, and through the so-called secondary or constitutional stage.

Various methods are resorted to for the introduction of mercury into the organism:

1. *Inunction.*—Before practicing inunction, the patient should take a warm bath, or, at least, wash the part to be operated on with soap and water. From fifteen to thirty grains of mercurial ointment is the quantity required for each inunction. The oleate of mercury in proportion of fifteen to thirty per cent in the solution may be substituted for the ointment, but the oleate is to be applied with a brush, and not be rubbed in. Sigmund, the great advocate for the inunction method, has prescribed certain rules, which should be followed. The ointment should be rubbed in with moderate friction by the palm of the hand: on the first day on the legs; on the second day on the thighs; on the third day on the abdomen and sides of the chest; on the fourth day on the back; on the fifth day on the arms. Mercurial inunctions are not borne equally well by all patients. Some are easily salivated, and others suffer from eczema or erythema. Moreover, the inunction treatment is filthy and troublesome, and it should, therefore, be restricted to those cases in which mercurials are badly borne by the stomach.

2. *Fumigation.*—Various mercurial preparations may be used—the sulphuret, the iodide—but calomel is the best. The apparatus consists of a spirit-lamp, a plate to hold the calomel, surrounded by a shallow vessel containing water, a blanket large enough to cover the patient and the apparatus. The calomel is volatilized by the heat of the lamp, and is deposited, together with the vapor of water, on the skin of the patient. About fifteen minutes is the time required for the bath, and the quantity of calomel used ranges from eight to fifteen grains. The method of fumigation is especially adapted to cases of the constitutional, or secondary, and to the tertiary, with ulcerations, when the state of the patient is such as to forbid the internal administration of mercurials.

3. *Hypodermatic Method.*—This consists in the introduction under the skin of corrosive chloride, or albuminate of mercury. ℞ Hydrarg. chlor. cor., gr. j; glycerini, ʒ j; aquæ destil., ʒ j. M. Sig.: *Ten minims a dose once a day.* This method is cleanly, quick in results, and more successful than any other in preventing relapses.

The peptonate of mercury, as advocated by Bamberger, has been much employed lately for the treatment of syphilis by the subcutaneous method; but the albuminate alone, without pepsin, is both more effective and less likely to set up local inflammation. The following formula for the preparation of albuminate of mercury, recommended by Gourgues, is probably the best now available for this purpose: Bichloride of mercury, gr. xv; distilled water, ʒ v. To this solution is added five drachms of white of egg, and, after thorough shaking, the mixture is incorporated with the following: Chloride of sodium (common salt), gr. xxx; distilled water, f ℥ ij. This mixture is then well agitated, and afterward filtered, after which sufficient distilled water is added to make the solution up to four fluid ounces. The dose of this solution for hypodermatic injection is from ♏ xv— ʒ ss. When finished, the solution is not clear, but rather semi-transparent; but it remains longer and better in solution than most of these preparations. The peptonate of mercury is not only variable in composition, but easily undergoes change, and is liable to produce violent local irritation. The albuminate prepared as above suggested is readily administered, is not painful, and is rarely followed by unpleasant accidents at the site of the injection. As regards the results of the administration on the progress of the disease, they are remarkable (Gourgues). According to Martineau, the hypodermatic mercurial treatment exercises on syphilis in its various manifestations an action much more effective, more energetic, and more rapid, than any other method hitherto proposed. The subcutaneous areolar tissue of the back is the best place for the injections. The number of them and the quantity of fluid used will depend on the stage of the disease, the severity of the manifestations, and the condition of the patient.

Besides the preparations above mentioned, other solutions of corrosive chloride have been proposed. Matthès recommends the following: Bichloride of mercury, gr. xv; chloride of sodium, gr. xxx; distilled water, f ℥ iij. Make a solution. Matthès had observed the action of this during two years at Auspitz's polyclinic. The usual dose was a Pravaz syringeful—fifteen to twenty minims—every two days. No irritation is produced beyond some tumefaction, and, in general, twenty to thirty injections sufficed to effect a cure.

Recently, Liebreich has brought forward the *formamide of mercury* as the most suitable preparation for the hypodermatic method. It is neutral in reaction, readily soluble in water, and does not coagulate albumen.

4. *Internal.*—This method, in the nature of things, must be most frequently resorted to. Various mercurial preparations are used by different syphilographers. The Ricord school prefer the green iodide; Sigmund, mercurial-ointment inunctions; Foerster, the yellow iodide; Berkeley Hill, the red iodide; Tilbury Fox, the cyanide; Bumstead advises mercurial pill, the green iodide, the bichloride, according to circumstances, but his preference is for the use of calomel by fumigation. That preparation of mercury is to be preferred which best agrees with the patient, is the rule.

The indications for the use of iodine preparations have already been stated, but it may be useful, now, to place in juxtaposition the comparative utility of mercury and iodine: mercury for the primary infecting sore; mercury for the affections of the skin, especially macular and papular exanthemata ; iodine for the tertiary symptoms : gummata ; tubercular syphilides ; serpiginous ulcers ; affections of the bones and periosteum, and nervous diseases.

Hydrargyrum cum creta is usually preferred for the treatment of *congenital syphilis.* Mr. Marshall recommends the twenty-per-cent ointment (the size of a pea) of the oleate of mercury, to be placed in the axilla night and morning for five or six days.

Local Uses of Mercurials.—Recent experimental investigations on the action and comparative germicide properties of the various antiseptics have shown the superiority of corrosive sublimate over all others ; hence it has come to be largely used in the dressing of *wounds,* and as a local application to *specific ulcerations,* etc. The acid nitrate of mercury is one of the best caustics for the destruction of *chancroid.* It should be applied with a glass rod after the surface of the sore has been well cleansed. It is now conceded that destruction of an infecting chancre does not prevent systemic infection. *Syphilitic warts* and *vegetations* on the genitals are amenable to the same treatment. *Erosions* and *ulcerated indurations* are best treated by "black-wash" (calomel, eight grains—lime-water, one ounce), or "yellow-wash" (one grain of corrosive sublimate to an ounce or two of lime-water). The surface of the sore may be kept wet with these lotions.

Ricord's treatment of *condylomata* consists in washing them with a solution of chlorinated soda, and then dusting them with calomel. Mercurial applications are of very great service in cutaneous affections of syphilitic origin. A drachm of calomel to an ounce of lard makes an ointment which is very serviceable in *herpes, psoriasis,* and *pruritus* of the vulva and anus. Ringer speaks of calomel-ointment in terms of great praise in various *itching* affections, especially of the anus and perinæum. In *acne,* lotions containing corrosive sublimate, and ointments of green and red iodide, are much employed : ℞ Hydrarg. chlor. cor., ℈j ; glycerini, ℥ss ; spts. vini rect., ℥vij ; spts. rosmar., ʒiv. M. For *acne* and *pityriasis* of the scalp : ℞ Hydrarg. iod. virid., gr. x ; adipis, ℥j. M. ℞ Hydrarg. iod. rubri, gr. v ; adipis, ℥j. M. For *acne indurata.* The following is Startin's lotion of corrosive sublimate for syphilitic eruptions : ℞ Hydrarg. chlor. cor., gr. iv ; acid. nitric. dil., ʒj ; acid. hydrocyan. dil., ʒj ; glycerini, ʒij ; aquæ, ℥viij. M. For *pityriasis, chloasma,* etc.

Lotions of corrosive sublimate are much employed in the treatment of parasitic skin-affections. The stronger ones must be used with caution. It is rarely necessary to use a lotion stronger than two grains to the ounce. The following is an excellent formula of Tilbury Fox : ℞ Hydrarg. chlor. cor., grs. iv ; alcohol, ʒvj ; ammoniæ muriat., ʒss ; aquæ rosæ, q. s. ad ℥vj. M. For *scabies, ptheiriasis,* and *tinea versicolor.* A scruple of corrosive sublimate to the ounce of simple ointment is an effective application in *favus* and *tinea tonsurans*, when used in the early stages of these affections.

Calomel *finely levigated* and dusted over the membrane by means of a camel's-hair brush is an excellent local application in *phlyctenular ophthalmia*. *Eczema of the margin of the eyelids* is quickly cured by rubbing in every night, after detaching the scales, a small quantity of the brown citrine-ointment. *Chronic inflammation of the external auditory meatus* is cured by the same application, viz., by allowing a small quantity of the brown citrine-ointment to remain in contact with the integument.

Mr. Marshall strongly recommends the oleates in *parasitic skin-diseases*. He employs a five-per-cent solution of oleate of mercury in oleic acid, adding an eighth part of ether. This is applied by means of a camel's-hair brush. It is used in *sycosis*, *tinea*, and *chloasma*, *porrigo*, *pruritus ani*, and *pruritus pudendi*. The oleates are extremely serviceable remedies for the local treatment of syphilitic induration, but they are not advisable when ulceration exists.

The oleate of mercury and morphia (obtained by the addition of the alkaloid morphia) is an elegant and efficient application in *superficial inflammations, especially of joints* of the rheumatic and arthritic varieties. Inflammatory indurations, left after the subsidence of acute trouble, are removed by the same combination. For application to these purposes Mr. Marshall employs a five-per-cent, ten-per-cent, and twenty-per-cent solution of oleate of mercury in oleic acid. To every drachm of such solution he adds one grain of morphia.

Mr. C. Bader, the eminent ophthalmologist of London, advises the following ointment in *conjunctivitis:* ℞ Hydrargyri oxidi rubri, gr. x; atropiæ sulph., gr. j; vaselin., ℥j. M. Dr. Seely, of Cincinnati, strongly urges the use of an ointment of the yellow oxide, eight or ten grains to the ounce of vaseline. He directs that the yellow oxide be triturated to the utmost degree of fineness, and then thoroughly incorporated with the vaseline, the result being a bright-yellow ointment. A portion of this is taken on a probe, the lid lifted up, and the whole is wiped off on the mucous membrane.

For *pruritus of the vulva*, the following lotion is recommended: Hydrarg. chlor. cor., one part; alum, 20 parts; starch, 100 parts; and water, 2,500 parts. The official ointment of the red iodide of mercury is an effective application in *simple hypertrophy of the thyroid gland*, and an *enlarged spleen*, or *ague-cake*. A bit of ointment, the size of a large pea, is thoroughly rubbed in over the affected organ, the sun's rays falling on the part if practicable, or the friction may be carried on before a bright fire, or without. As soon as the skin becomes sore the applications are suspended until it recovers, when they may be resumed. The applications should be made daily.

For that parasitic affection of the skin, *pityriasis*, there is no lotion so effective as a strong solution of corrosive sublimate—℈j—ʒj—℥iv of rose-water. It need hardly be observed that these strong solutions require very careful handling. Less than necessary will fail, and application to an abraded surface will induce toxic symptoms.

As a germicide, corrosive sublimate now occupies the first place, and is, in consequence, largely utilized in medical, surgical, and obstetrical practice. In parasitical diseases, as *diphtheria*, *typhoid*, *gonorrhœa*, etc., excellent results have been obtained by its use (Paul, Martineau, Moutard-Martin). To destroy the infection of wounds, to sterilize instruments, to remove decomposing materials, and to prevent systemic poisoning, corrosive sublimate continues to be employed on an increasing scale—only limited by the danger of its toxic action. It must be remembered that this danger is by no means remote. An early manifestation of toxic action is the occurrence of enteritis, examples of which have been recently published by Fraenkel, Peabody, and others, when a solution of one part to one thousand only had been applied topically. Well-authenticated instances of toxic effects have become so numerous as to demand intelligent supervision during the whole period of its application.

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Aurum.—Gold. *Or*, Fr.; *Gold*, Ger.

Auri et Sodii Chloridum.—Gold and sodium chloride. A mixture of equal parts by weight of dry gold chloride and sodium chloride. An orange-yellow powder, odorless, having a saline and metallic taste, and very soluble in cold water. Dose, gr. $\frac{1}{20}$—gr. $\frac{1}{5}$. The chloride of gold is not official, and is not suitable for internal administration.

Antagonists and Incompatibles.—Eggs, albumen, milk, flour, are chemical antidotes. The contents of the stomach should, of course, be evacuated. The principles of treatment are the same as for poisoning by corrosive sublimate.

Synergists.—The salts of mercury, especially the corrosive chloride, are very similar in action to the chlorides of gold, and are therefore synergistic.

Physiological Action.—The chloride of gold is a caustic in its local action. In toxic dose it excites violent gastro-enteritis, accompanied by such nervous phenomena as cramps, convulsive trembling, insomnia, priapism, insensibility, etc. In small medicinal doses these auric preparations promote the appetite and the digestive capacity. If long continued, especially if the dose be a full medicinal one, epigastric pain and distress are excited, nausea is induced, and loss of appetite follows. Constipation is usually produced by the preparations of gold, and this, notwithstanding an increased secretion of the intestinal glandular apparatus is one of the results of their administration. These preparations do not probably entirely enter the blood from the stomach, but part passes to the intestinal canal, is there decomposed, and is absorbed as oxide in combination with albumen. This is, however, conjectural. They are readily soluble and are very diffusible substances. What particular influence they exert on the composition and function of the blood is at present quite unknown. A form of fever, known as *auric fever*, is caused by their prolonged administration. This fever is accompanied by profuse sweats, a very abundant flow of urine, and increased salivary secretion. The salivation caused by the preparations of gold differs from the mercurial in that there is no tenderness nor ulceration of the gums.

Peculiar effects on the mental state are produced by the administration of the auric preparations. The functions of the mind become more active, and even excited, and a state of cheerfulness is induced. In men, marked aphrodisiac effects are produced, and the erections are often painful; in women, increased venereal desires and augmentation of the menstrual flow are observed.

The elimination of the auric preparations takes place by the liver, the intestinal canal, but chiefly by the kidneys. The urine assumes a bright-yellow color.

Prolonged administration of medicinal doses induces epigastric heat and oppression, headache, dryness of the throat and mouth, gastro-intestinal irritation, fever.

THERAPY.—The chloride of gold and sodium, in small doses ($\frac{1}{20}$ grain) three times a day, will relieve *nervous dyspepsia. A red and glazed tongue, epigastric pain, increased by taking food, and a tendency to relaxation of the bowels after eating,* are indications for the use of this salt. *Catarrh of the duodenum, catarrh of the bile-ducts,* and *jaundice* dependent thereon, are symptoms which may usually be removed by the salts of gold if given in small doses.

Injections of gold and sodium chloride are strongly advocated by Drs. Shurley and Gibbes, of Michigan, in cases of *pulmonary tuberculosis.*

In certain convulsive neuroses of the respiratory organs, the chloride of gold and sodium has seemed to be very effective; for example in *laryngismus stridulus, whooping-cough,* etc.

Amenorrhœa, dependent on torpor of the ovaries, may be removed by the persistent use of auric preparations. *Chronic metritis,* with scanty menstruation, is often remarkably benefited by them. *Sterility,* dependent on these states, or due to coldness, is more certainly cured by these agents than by any other merely medicinal means. It is said by Martini that the tendency to *habitual abortion* may be averted by the use of chloride of gold.

Decline of the sexual power in man may be prevented by the use of gold salts, and the following are symptoms which may be removed sometimes by them: *diurnal seminal losses, weak and inefficient erections, inability for the sexual congress, due to irritability of the sexual organs.* They increase the frequency of the nocturnal losses in those who are suffering from plethora of these organs. Cases that are benefited by the bromide of potassium are increased by the chloride of gold, and *vice versa.*

The author calls especial attention to the use of the salts of gold in *chronic Bright's disease*—granular and fibroid kidney. His experience, narrated in successive editions of this work, has continued to be highly favorable, and various confirmatory observations have been published by others. The double chloride—of gold and sodium—is the preparation to use, and the dose will vary from $\frac{1}{10}$—$\frac{1}{20}$ grain.

The nature of the curative action consists in the impression made on the connective-tissue elements; it prevents or lessens the overgrowth, and hence it is now utilized in the treatment of the various *scleroses*—of the liver, of the kidney, of the arterial system (*arterio-sclerosis*), and of the nervous system.

Excellent results are obtained from the use of the double chloride in certain forms of mental disorder: e. g., *melancholia*, *hypochondria*, and allied mental states, accompanied by depression. *Vertigo* and *vertiginous sensations*, when due to stomach-disorders, are often removed by minute doses, but plethora and increased intracranial blood-pressure contraindicate their use; on the other hand, they have a high degree of utility when there is present the condition of cerebral anæmia. The author has been favored with a private communication from Dr. Bauduy, of St. Louis, in which this experienced and able physician expresses his confidence in the value of this remedy in the treatment of hypochondriasis and melancholia. In Chaucer's "Canterbury Tales," which appeared near the close of the fourteenth century, we find the following couplet:

> "For gold in physic is a cordial,
> Therefore, he loved gold in especial."

Also, in that curious mixture of scholastic learning and whimsical suggestion, the "Anatomy of Melancholy," gold is recommended as the best remedy for mental depression.

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Argentum.—Silver. *Argent*, Fr.; *Silber*, Ger.

Argenti Oxidum.—Silver oxide. An olive-brown powder, very slightly soluble in water. Dose, gr. ss.—grs. ij, in pill.

Argenti Nitras.—Silver nitrate. A heavy, colorless, anhydrous salt, wholly soluble in distilled water, and crystallizing in shining, rhombic plates. Dose, gr. $\frac{1}{4}$—gr. ss, in pill, or in solution.

Argenti Nitras Fusus.—Fused silver nitrate. In cylindrical pieces. It is only used for topical applications.

Argenti Nitras Dilutus.—Diluted (mitigated) silver nitrate. Silver nitrate, 30 grm.; potassium nitrate, 60 grm. Formed in pencils or cones.

Argenti Cyanidum.—Silver cyanide. Is a white powder, insoluble in water. Dose, gr. $\frac{1}{40}$—gr. $\frac{1}{20}$, in pill-form.

Argenti Iodidum.—Silver iodide. An amorphous powder, yellowish in color, without taste, and insoluble in water or alcohol. Dose, gr. $\frac{1}{10}$—gr. $\frac{1}{4}$.

ANTAGONISTS AND INCOMPATIBLES.—The soluble chlorides and all substances containing them are incompatible with the nitrate of silver; hence most of the natural waters decompose it, because they contain more or less common salt. An insoluble chloride of silver is the result of the decomposition. The following mineral acids and their salts are chemically incompatible: Sulphuric, muriatic, tartaric, and sulphurous. Alkalies and their carbonates, astringent infusions, and lime-water are incompatible. In cases of poisoning by nitrate of silver, common salt is the appropriate antidote. This should be given in solution very freely, to act as an emetic as well as chemical antidote.

Therapeutically the salts of silver are antagonized by all those agents which promote constructive metamorphosis.

SYNERGISTS.—All agents promoting waste, as mercury, iodides, etc., favor the action, therapeutically, of nitrate of silver.

PHYSIOLOGICAL ACTIONS.—Nitrate of silver acts chemically on the tissue to which it is applied. It combines with the albumen, and excites a superficial inflammation, producing in some subjects vesication, in all a whitish eschar. It is, therefore, an escharotic, but of very limited activity. The white eschar produced by it, subsequently—under the influence of light—becomes brownish-black.

Nitrate of silver has a strong metallic, styptic taste. A strong solution, brushed over the mucous membrane, whitens it. In the stomach, the salts of silver produce a sense of warmth at the epigastrium, and, in large (toxic) doses, excite a violent gastro-enteritis. Meeting in the stomach soluble chlorides, undoubtedly the insoluble chloride of silver is formed, but a portion of the salt, probably, at once enters into combination with albumen and peptones. That the action of nitrate of silver, when swallowed, is not that of the chloride, has been experimentally shown; hence the conversion of the nitrate salt into chloride does not suffice to explain the effects which ensue. Increased secretion from the intestinal glandular apparatus is produced by the silver salts, and the alvine dejections are softer and more frequent. Long-continued use of these agents will cause gastro-intestinal catarrh.

The salts of silver most probably enter the blood as albuminates and peptonates. They effect very important changes in the blood, which becomes darker and more fluid, the red corpuscles paler and altered in outline, the hæmoglobin converted into hæmatin. A slight lowering of the temperature is a result of these changes in the composition of the blood. Various tissues of the body undergo pathological alterations. The epithelium of the intestinal mucous membrane, of the kidneys and liver, becomes swollen and cloudy, and sometimes fatty. The amount of bile is increased, and albumen frequently appears in the urine. The nutrition of the body is impaired and a progressive diminution in weight and strength takes place. The venous system is found in a state of stasis; transudations take place, the action of the heart is rapid and irregular, and the respiration is embarrassed.

The nervous system participates in the general impairment of structure; tetanic convulsions, paralysis, and insensibility, ensue. The paralysis is not due to alterations in the muscular system—for the muscles preserve their irritability—but is centric in origin. It is true the muscles, in poisoning by silver, become granular and their striæ obliterated, but their contractility is not destroyed.

Only a minute part of the silver administered is eliminated by the kidneys; most of it escapes by the liver and the intestinal glands; but a portion remains permanently deposited in the tissues if its administration has been protracted. Rarely is it safe to continue the use of the preparations of silver longer than six weeks, and occasional purgatives should be given to promote elimination. An olive, slate-colored, or grayish-brown discoloration of the various tissues of the body results from a deposition of silver. This is usually first seen at the margin of the teeth or on the inside of the lips and cheeks, and is an indication that the system is becoming saturated. I find in Sieveking, "On Epilepsy," the following instructive instance of argyria: "The patient, a man aged sixty, became epileptic in March, 1856, and was treated with nitrate of silver almost from the commencement; for nine months he took a daily pill containing six grains, so that, during that time, he swallowed nearly three and a half ounces. Toward the end of July the skin began to be discolored, but, in spite of gastric symptoms, the remedy was persevered in. In 1857 hæmatemesis and other symptoms of gastric ulceration supervened, while the severity of the epilepsy had abated, and, having in the mean time come to England, he was admitted to the German Hospital, where he soon died. The special interest attaching to the autopsy is connected with the extent to which the silver had been deposited in the tissues. The parts in the face which had exhibited the greatest intensity of discoloration, owing to their containing more blood, now presented a tint uniform with the rest. In the brain the choroid plexuses presented a uniform grayish-blue tint. The lungs were tuberculous and pneumonic, the heart hypertrophic. The stomach contained a large quantity of acid, brown liquid streaked with blood, and at the upper part of the posterior wall was a large ulcer, at the base of which was an orifice blocked up by the adherent pancreas. The mucous membrane of the duodenum and jejunum was dotted over with many small black granules, most closely aggregated along the folds. In the ileum these spots became more and more scanty. . . . The spleen was small, its veins had an ashen hue, which was due to a finely-granular precipitate upon their coats. The liver was small, congested, and fatty; the small branches of the vena portæ and of the hepatic veins presented the same precipitate of silver throughout, but the capillaries were free from it. Fine sections of the hepatic tissue showed numerous black dots, each of which occupied the center of an acinus, corresponding to the point of exit of a central vein, and the color was produced by a black margin surrounding the caliber of the artery. The largest argentine deposit was in the kidneys. . . . The pyramids all exhibited a dark-gray color, which was deepest, and all but black, near the papillæ. The tubules in these parts were entirely invested with a dense precipitate. . . . Parts of the skin taken from the temporal, axillary, and digital regions, were examined. Transverse sections showed a pale, purplish streak immediately underneath the rete Malpighii, following the undulations of the cutis. . . . The glandular epithelium uniformly presented fatty degeneration."

A persistent and long-continued use of the iodide of potassium and of the hyposulphite of soda has, in a few fortunate instances, caused the absorption and excretion of the silver deposits. The action of these systemic remedies for the discoloration may be aided by baths of the hyposulphites and by the cautious use of lotions containing the cyanide of potassium, which possess a decided solvent power over the silver deposits.

THERAPY.—The oxide and the nitrate of silver are extremely serviceable remedies in the so-called *nervous dyspepsia*, and in *chronic gastric catarrh*. They are indicated in the following state of things: Pain after taking food, lasting for an hour or more (gastralgia), the digestion, although slow, being good; burning pain, with pyrosis, coming on after the completion of the stage of stomach digestion; eructations of food, with sour and acrid matters—the first being a gastralgia, and the other states being caused by gastric catarrh, and consequent fermentation of the starch, sugar, and fats. ℞ Argenti oxidi, grs. v; ext. hyoscyami, grs. v. M. Ft. pil. no. x. Sig.: One three times a day before meals. In *chronic gastric catarrh*, Frerichs recommends the following formula: ℞ Argenti nitrat., grs. xv; aq. destil., q. s.; ext. belladonnæ, grs. x; ol. caryophylli, gtt. x; rad. gentian pulv., ext. gentianæ, āā q. s. ut ft. pil. no. lx. Sig.: One pill three times a day. When there is much pain present, Wilson Fox highly commends the combination of nitrate of silver and opium in chronic gastric catarrh, but, as constipation so frequently attends this state, belladonna or hyoscyamus is usually to be preferred. Notwithstanding the strong opinion which Brinton has given adversely to the use of the salts of silver in *ulcer of the stomach*, the author agrees with Fox that these agents are, in this affection, next in value to bismuth. The oxide, or the nitrate, may be given in pill-form, as above, or the nitrate in solution. In these stomach-affections, as a rule, the oxide of silver—being free from the causticity of the nitrate—is preferable.

In *jaundice dependent on catarrh of the biliary ducts*, especially when there are present considerable pain and stomach-disorder, the salts of silver not only give relief to some of the more distressing symptoms, but assist materially in restoring the functional activity of the liver. As respects these hepatic disorders, silver has an action similar to arsenic, manganese, mercury, and some other mineral remedies.

Frequently nitrate of silver is remarkably beneficial in *cholera infantum*, after the acuter symptoms have subsided. The following is an excellent formula for a child a year old: ℞ Argenti nitrat., gr. j; acid. nitric. dil., ♏ viij; tinct. opii deod., ♏ viij; mucil. acaciæ, ℥ ss; syrup. simplicis, ℥ ss; aquæ cinnamomi, ℥ j. M. Sig.: A teaspoonful every three, four, or six hours. The nitrate of silver is also an efficient remedy in that form of *diarrhœa in children* in which the stools are white, pasty, and offensive, and the urine is high-colored and acrid. In *dysentery*, both of children and adults, after the acute symptoms have ceased, and in *chronic dysentery*, the nitrate of silver is a most efficient remedy. In some epidemics of *acute dysentery*, when the constitutional condition is one of depression, it is equally effective. In these maladies it is better to prescribe the nitrate in pill-form (gr. ¼—gr. j) combined with opium. With the stomach administration of the nitrate may be conjoined its local application to the rectal mucous membrane, and even in favorable instances to the descending colon. In using nitrate of silver by enema, the application, to be effective, should be made through a flexible tube passed cautiously to the sigmoid flexure or beyond. The bowel, previous to the introduction of the silver solution, should be as thoroughly washed out as possible by tepid water. From ten to twenty grains of the nitrate of silver, to a pint of water, is a suitable proportion for an enema.

Obstinate *dysenteric discharges*, either alone or mixed with healthy-formed fæces, are not unfrequently caused by an *ulcer of the rectum*. The most effective treatment for such an ulcer consists in the application to it, through a suitable speculum, of the solid stick of nitrate of silver.

The author's experience justifies him in asserting that the most effective remedy for the *diarrhœa of phthisis* is nitrate of silver combined with opium. When the *diarrhœa of typhoid fever* resists bismuth, Hope's mixture, and laudanum enemata, a satisfactory result may often be obtained by nitrate of silver, as follows: ℞ Argenti nitrat., grs. iij; pulv. opii, pulv. ipecac., āā grs. vj. M. Ft. pil. no. xij. Sig.: One every four or six hours. The nitrate of silver is one of the numerous remedies which have been used in the treatment of *cholera*.

Formerly nitrate of silver was much employed in the treatment of *epilepsy*, but it has justly fallen into disuse, for, besides the danger of tinting the skin, it is not as effective as much less objectionable remedies. Iodide of silver has proved very useful in the treatment of *whooping-cough*, in the hands of Dr. Bell, of Glasgow. He gives one eighth of a grain. Since proposed by Wunderlich, this agent has been fairly tested in the treatment of *posterior spinal sclerosis* (progressive locomotor ataxia), and seems to have some influence in retarding the progress of the disease.

LOCAL USES.—Nitrate of silver is largely used as an external application. A case has recently been reported in which argyriasis was produced by the free application of this salt to the fauces, hence some care should be exercised in applying it to the mucous membranes. For external use, the cylinder and solutions of various strengths are employed. The "mitigated" stick is used chiefly by ophthalmologists. The most satisfactory solution for local application to the skin is obtained by dissolving the salt in nitrous ether (gr. v—℈j—℥j of ether). This solution acts more energetically than the aqueous solution, and will readily vesicate.

Solutions of nitrate of silver are much less frequently applied than formerly to *inflamed tonsils, diphtheritic affections of fauces, acute laryngeal troubles, œdema of the glottis,* etc. In the incipiency of tonsillitis, a strong solution (℈j—ʒj—℥j) may sometimes avert the attack, but if the inflammation be well established the irritant action of the caustic increases the morbid process. The most enlightened modern authorities (Oertel) condemn the use of caustics in diphtheria; forcible detachment of the exudation only increases the chances of systemic infection, and injury done to the surrounding healthy mucous membrane invites the extension of the false membrane. A sufficient quantity of silver solution, to be effective, can not be applied to the larynx, nor even to the aryteno-epiglottidean folds, without the aid of the mirror, and this manipulation is hardly available when a state of acute inflammation exists. *Follicular pharyngitis* is one of the affections which can be successfully treated by systematic local applications of silver solution. *Catarrh and ulceration of the posterior nares* may be cured by persistent use of the same remedy, the application being made by a suitable sponge probang, or brush, passed behind the veil of the palate. The appropriate strength for these purposes will depend, in part, on habit (grs. v—℈j—℥j). Very weak solution of nitrate of silver (gr. j—℥j) is sometimes used by the spray-douche (glass tube) in *chronic inflammation of the pharynx, larynx, and trachea.* Besides the ineffectiveness of this method, it is objectionable because the silver spray stains the face and clothing of the patient, unless a shield is very carefully used. To *ulcers of the tonsils, tongue, syphilitic and otherwise,* the solid nitrate is often used. It is a very painful application, and possesses but slight, if any, advantages over carbolic acid, which is anæsthetic after the first contact.

A strong solution of nitrate of silver, especially in nitrous ether, is a most efficient application to check inflammation in superficial parts, e. g., *boils, felon* (paronychia), *thecal abscess, orchitis, synovitis,* etc. It is essential to the success of this treatment that the application be made early. According to the method of Mr. Furneaux Jordan, it is better to make these applications to the adjacent "vascular territory," than to the inflamed part directly. To illustrate: In the case of orchitis, instead of painting the silver solution over the testicle, it is better to apply it along the groin and inner face of the thigh, over the course of the great vessels.

Mr. Higginbottom, who is the author of this method of treatment, says that "we have no therapeutic agent so safe, powerful, or efficacious, as the nitrate of silver in subduing external inflammation when properly applied. It has been invariably successful in my hands for nearly the last forty years." Such unstinted praise from so eminent an authority deserves our most respectful consideration. As the proper application of the remedy is so important, it were better to follow literally the method of Mr. Higginbottom: "The affected part should be well washed with soap and water, then with water alone, to remove every particle of soap, as the soap would decompose the nitrate of silver; then to be wiped dry with a soft towel. *The concentrated solution of four scruples of the nitrate of silver to four drachms of distilled water is then to be applied two or three times on the inflamed surface and beyond it, on the healthy skin, to the extent of two or three inches.* The solution may be applied with a small piece of clean linen, attached to the end of a short stick; the linen to be renewed at each subsequent application. . . . In about twelve hours it will be seen whether the solution has been well applied. If any inflamed part be unaffected, the solution must be immediately reapplied."

The method of Mr. Higginbottom is extremely effective in *traumatic erysipelas.* The common *facial erysipelas* rarely requires anything but the simplest application. The concentrated solution of nitrate of silver should be thoroughly applied to *malignant carbuncle of the lip*, and to the adjacent healthy skin for a short distance. The *pitting of small-pox* may be prevented by rupturing each pustule and inserting into it a sharply-pointed pencil of the nitrate of silver. According to Mr. Higginbottom, the same result may be accomplished, and with greatly less labor, by applying his solution in the manner above indicated.

The solution of nitrate of silver in nitric ether (℈ij— ℥j) is recommended by Fox in the chronic forms of *erythema, eczema, psoriasis*, and [illegible] *ulcers, discharging sores with flabby granulations*, are improved in character and made to heal by application of Higginbottom's concentrated solution, or of solid caustic.

[illegible] a very common [illegible] *granular cervicitis*, [illegible] are effectively treated by nitrate of silver applications. The solid caustic may be quickly brushed over the mucous membrane, or a concentrated solution may be applied with a suitable "applicator."

There is no doubt that solid caustic may be applied with safety in chronic cases to the interior of the uterine cavity, after preliminary dilatation of the cervical canal. This is a most effective treatment, but injury is often done by over-stimulation and too prolonged contact of the caustic. Induration of the cervix and narrowing of the cervical canal are sometimes produced by injudicious use of the solid caustic. That troublesome affection, *pruritus of the vulva*, may often be removed, even when due to pregnancy, by washing the neck, and the cervical canal so far as it is accessible, with a strong solution of the nitrate of silver (℈j—℥j). When the pruritus is due to a vesicular eruption on the genitals, the application should be made to the affected part. *Gonorrhœa* (vaginal) of the female is most quickly removed by applying through the speculum, and to every part of the canal, a concentrated solution of silver nitrate (℈j—ʒj). In the male, *gonorrhœa*, at its first appearance, may sometimes be aborted by a strong injection (ʒj—℥j), but unfortunately the period is usually past when this violent practice may be advised. Weak solutions (gr. j—grs. v—℥j) are, as a rule, more efficient, as they are unquestionably safer. *Cauterization of the prostatic part* of the urethra was at one time vulgarized in the treatment of *spermatorrhœa* by the influence of Lallemand, but this dangerous practice is rarely necessary. The author coincides with Mr. Furneaux Jordan in the expression of the belief that a vesicating solution of nitrate of silver applied to the perinæum is as generally useful and, of course, entirely without danger.

Solutions of nitrate of silver are much used in ophthalmic and aural surgery. To *granular lids*, a strong solution (℈j—℥j) is applied ; to *acute conjunctivitis*, a weak solution (gr. j—grs. iv—℥j); but generally ophthalmologists prefer the zinc and copper salts in the treatment of these affections. The incautious use of silver salts, when there are corneal ulcers, may result in unsightly deposits and opacities. *Otorrhœa*, *eczema of the external auditory meatus*, and *chronic inflammation of the external ear*, may be cured by silver solutions properly applied. A commencing *furuncle* of the external canal may sometimes be aborted by application of Mr. Higginbottom's solution.

Dr. Mays, of Philadelphia, has lately published a method of treating phthisis by injecting a solution of nitrate of silver along the course and above the pneumogastric nerve. This counter-irritant thus used is an application of Dr. Mays' theory that consumption is a neurosis, and to be affected most favorably by acting on the diseased organ through irritation of its principal nerve.

Besides the above-mentioned external applications of nitrate of silver, this salt is also used according to the method of Luton, entitled "parenchymatous substitution." This consists in injecting, with a hypodermatic syringe, a few drops of concentrated solution into the parenchyma of oagans—an irritant injection. *Cystic tumors* (wens), *small fatty tumors, abscesses,* and *hydrocele,* may be cured by injecting five to ten drops of a strong solution (℈j—ʒij). In the case of cysts and hydrocele, the contents may be allowed to escape through the needle, and then the irritant solution be injected. More or less active inflammation follows, and the sac, after a variable stage of suppuration, becomes entirely obliterated.

Old and intractable cases of *sciatica* that resist other means, including hypodermatic injection of anodynes, are sometimes permanently relieved by injecting deeply into the neighborhood of the affected nerve ten to twenty drops of a solution of nitrate of silver. Suppuration usually follows, and the local inflammatory process terminates the previously-existing nerve-lesion (parenchymatous substitution).

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New Silver Preparations.—Although the new silver remedies are in the experimental stage, some reference should be made to their employment. Instead of the silver nitrate as a topical agent, combinations of silver with ethylene-diamine, as a phosphate, and known as argentamine, or as a proteid product called protargol, or in combination with casein, and known as argonin, have come into use.

Argentamine is an 8-per-cent solution of silver phosphate. This occurs as an alkaline liquid, which becomes yellow on exposure. It has antiseptic properties, and is a valuable injection in gonorrhœa, in the proportion of 1 to 4,000.

Argonin is a white powder not soluble in cold but soluble in hot water. It contains 4·25 per cent of silver. It is an antiseptic and topical remedy, chiefly used in the treatment of gonorrhœa, in a 1- or 2-per-cent solution.

Protargol is like argonin, but it contains 8 per cent of silver, and is soluble in water. The strength of the solution to be used is from $\frac{1}{10}$ to 1 per cent. It is said to be an effective remedy for gonorrhœa, and, according to Prof. Neisser, the best of all that has been proposed for this purpose.

Crede's Silver Preparations.—The distinguished professor at Dresden has brought forward a system of treatment in which salts of silver are chiefly employed.

Argenti Citras.—Citrate of silver. This occurs as an odorless white powder, but little soluble in water, but more freely soluble in albuminous fluids, so that when used as a dusting powder on wounds it diffuses through exudations and neighboring tissues, forming an antiseptic application of great permeability.

Argenti Lactas.—Lactate of silver is a white odorless powder, soluble in water in the proportion of 1 to 15. For disinfecting the skin it is used in the strength of 1 to 1,000; for irrigating wounds, 1 to 10,000; for sterilizing ligatures, 1 to 200.

Soluble Metallic Silver—Argentum Colloidale.—Collargolum is possessed of the most valuable properties. This preparation is an allotropic modification of metallic silver, and is soluble in water and albuminous fluids generally. When introduced by inunction or hypodermatically, or by application to wounded surfaces, or when swallowed, it enters the vascular system, the blood, and lymphatics, and becomes an active germicide or antitoxic agent. Although so diffusible, permeating all parts of the tissues, it seems never to induce argyria.

Collargolum, or soluble metallic silver, occurs in the form of hard pieces, having a somewhat metallic luster. The dose for internal administration in pill form is ½ to 1 gr. The gastro-intestinal catarrhs, tuberculosis of the intestine, infectious entero-colitis, and other septic states, are successfully treated by this remedy. It may also be employed subcutaneously in the proportion of 1 to 200 parts of distilled water, repeated once or twice a week.

As a topical agent, it may be used in surgical diseases, wounds, injuries, and in cases of septic decomposition. Wherever diseases—either pure or mixed infectious—are caused by the staphylococcus, the streptococcus, and other forms of low organisms, this remedy is effective in a high degree.

Unguentum Crede is the proprietary form in which this remedy is now offered to the medical public. Rubbed into the skin, collargolum diffuses readily into the lymphatics and blood, acting powerfully on septic processes. It is recommended that three grammes be used for adults. The remedy should be applied by inunction to the thoroughly cleansed skin for twenty or thirty minutes. Where inunctions are not feasible, collargolum should be given in pill form, made up with sugar of milk and some glycerin and water. It is also recommended in solution, thus: ℞ Argenti colloid (Crede), 0·5 or 2; distilled water, 50 to 200 grammes; egg albumin, 0·5 to 2.

Of this a teaspoonful to a tablespoonful is to be taken with a glass of water or a cup of tea a quarter to a half an hour before meals.

These methods—in pill or solution—are said to be especially applicable to the chronic infectious, general tuberculosis, gonorrhœal rheumatism, gonorrhœa, etc.

For subcutaneous injection, a solution of argentum colloidale—1 to 200 of distilled water—of which one half to two syringefuls (seven to thirty grains) are to be given in one or several places according to the size of the lesion. Very little pain is caused by the injection. It is to be repeated once a week or once in two weeks.

Collargolum is also used in bougie form for the treatment of infectious fistulæ, uterine, and urethral diseases. The mass is made of sugar of milk, gum, albumin, and glycerin, molded into the desired shapes. Each bougie may contain three grains of the medicament. Collargolum may also be dissolved in sterilized water (seven to fifteen grains to the pint of water) and used as a topical application, or as a rectal enema by the addition of some albumin.

The extraordinary claim is made that the various applications containing the soluble silver diffuse into the system by the lymph stream, preventing all growth of the staphylococci and streptococci. The evidence as furnished by Prof. Crede and his friends seems to justify the claims they have put forth.

That such results are possible may be held, seeing that the actions of mercury are similar, and that the metallic mercury and mercurial salts thus diffuse through the lymph channels.

Cuprum.—Copper. *Cuivre*, Fr.; *Kapfer.*, Ger.

Cupri Acetas.—Copper acetate. (Not official.) Deep-green, prismatic crystals, yielding a bright-green powder, efflorescent on exposure to air, odorless, having a nauseating, metallic taste and an acid reaction. Soluble in 15 parts of water, and in 135 parts of alcohol at 60° Fahr. Dose, gr. $\frac{1}{10}$—gr. $\frac{1}{4}$.

Cupri Sulphas.—Copper sulphate. Blue vitriol. In blue crystals, slightly efflorescent in the air, and soluble in 2·6 water at 60° Fahr. Ammonia throws down from the solution a precipitate, which is wholly dissolved when the alkali is added in excess. Dose, gr. $\frac{1}{6}$—gr. ss.

Cuprum Ammoniatum.—Ammoniated copper. (Not official.) A deep, azure-blue powder, having an ammoniacal odor, and a styptic, metallic taste. It is soluble in water. Dose, gr. $\frac{1}{6}$—gr. j.

ANTAGONISTS AND INCOMPATIBLES.—Alkalies and their carbonates, lime-water, mineral salts (except the sulphates), iodides, and most astringent vegetables, are chemically incompatible with the salts of copper. In cases of poisoning, white of eggs and milk should be given freely, but evacuation of the contents of the stomach is necessary, for the albuminate of copper is not devoid of toxic power. The most effective chemical antidote is said to be the ferrocyanide of potassium, forming the insoluble ferrocyanide of copper. Magnesia has also been proposed, but it should not be relied on to the exclusion of albumen and ferrocyanide of potassium, nor should any antidote be used without evacuating the stomach contents by emetics or the stomach-pump.

SYNERGISTS.—The salts of lead, tin, zinc, mercury, silver, gold, favor the therapeutic action of the copper-salts. All of these agents agree in this: they promote waste, and affect the functions of the nervous system secondarily. All unfavorable hygienic conditions, which depress the functions of the body, increase the activity of the copper-salts.

PHYSIOLOGICAL ACTIONS.—The salts of copper have a styptic, metallic taste. When a poisonous dose of a copper-salt has been taken the following symptoms, referable to the digestive organs, appear: A strong metallic taste, burning and constriction of the throat, increased flow of saliva, burning pain at the epigastrium, with griping and colic-pain of the intestines, nausea and vomiting. The vomited matters have usually a bluish or greenish color, and the intestinal evacuations, which begin in a few minutes after the poison has been swallowed, are dark-greenish and frequently bloody. These are the symptoms produced by the irritant poisons, and have no special characters, except, it may be, the *color* of the evacuations. The salts of copper, being diffusible substances, quickly enter the blood, and the systemic symptoms which follow are referable to the nervous system and the organs of excretion. In the blood, as is the case with the other metallic poisons, copper probably exists in the form of an albuminate in close relation to the red blood-globules. The breathing becomes short, hurried, and labored; the pulse small, quick, and weak; the skin cold and perspiring, and restlessness, headache, trembling, cramps, vertigo, and stupor, are followed by convulsions (clonic or tetanic), paralysis, and insensibility.

Inhalation of cupreous fumes, as in certain occupations in the arts, the slow introduction of small quantities, as occurs sometimes from cooking acid fruits in copper vessels, or the prolonged medicinal administration of moderate doses of a copper-salt, will produce the symptoms of chronic or slow poisoning. When inhaled, the symptoms first observed are those of bronchial irritation and bronchial catarrh (Hirt). Internally administered, a gastro-intestinal catarrh is produced, epigastric pain is experienced, nausea, vomiting, colic, tenesmus, and dysenteric discharges, and complete anorexia occur. The loss of appetite, and the interference with digestion, as well as the injury done to the red blood-globules, impair the strength and increase the waste of the tissues. A purplish line along the margin of the gum has been observed, salivation and ulceration of the gums not unfrequently occur, and occasionally jaundice is present as one of the symptoms. As regards the nervous system, headache, muscular trembling, paresis of the limbs, and sometimes paralysis, altered sensations, defects of co-ordination, impaired mind, result. These nervous symptoms, with bronchial and gastro-intestinal catarrh, are usually grouped together in the case of chronic cupreous poisoning in artisans.

Copper is eliminated by the liver, intestinal canal, salivary glands, and kidneys. As is the case with the other metallic poisons, copper tends to accumulate in the liver.

THERAPY.—The sulphate of copper is one of the remedies sometimes effective in the *vomiting of pregnancy*. For this purpose not more than one twentieth of a grain, three times a day, is admissible. ℞ Cupri sulphat., grs. ij; aquæ destil., ℥ ss. M. Sig.: Six drops a dose.

As sulphate of copper is a very prompt and effective emetic, it is frequently resorted to in cases of *narcotic poisoning*. ℞ Cupri sulphat., grs. vj; aquæ destil., ℥ ij. M. Sig.: *A tablespoonful every fifteen minutes until vomiting ensue.* It may be used under the same circumstances, but is by no means so desirable *an emetic, in croup*, as subsulphate of mercury. Minute doses of sulphate of copper render excellent service in *gastro-intestinal catarrh*, especially when the bowels are relaxed. ℞ Cupri sulphat., gr. j; ext. nucis vom., grs. iv. M. Ft. pil. no. xvj. Sig.: One three times a day before meals. When the food taken gives rise to colic, which is quickly followed by the inclination to stool, there should be combined with the above prescription one grain of morphine sulphate. When the constipation coexists with intestinal catarrh, the following prescription is useful: ℞ Cupri sulphat., gr. j; ext. physostigmæ, ext. belladonnæ, ext. nucis vom., āā grs. iv. M. Ft. pil. no. xvj. Sig.: One pill, three times a day, before meals.

The sulphate of copper is a most useful remedy in *acute dysentery*. ℞ Cupri sulph., gr. ss; magnesiæ sulph., ℥ j; acid. sulph. dil., ʒ j; aquæ, ℥ iv. M. Sig.: A tablespoonful every four hours. After the acuter symptoms have subsided, the sulphate of copper may be given with morphine and opium. Of all the metallic astringents employed for this purpose, sulphate of copper is the most effective in *chronic diarrhœa* and *chronic dysentery*. ℞ Cupri sulphat., grs. j; morphinæ sulph., gr. j; quininæ sulph., grs. xxiv. M. Ft. pil. no. xij. Sig.: *One pill three times a day.* Sulphate of copper is indicated when there are present colic-pains, tenesmus, and the stools, partly feculent, contain mucus streaked with blood. When *tolerance* is established, the quantity of copper in the above formulæ may be increased slowly to one fourth of a grain. Rarely can more than one twelfth of a grain be given to an adult unaccustomed to its use, without causing very unpleasant nausea and depression.

The *dysentery and cholera infantum* of children, and the *chronic* *entero-colitis* which sometimes succeeds to measles, are often remarkably benefited by minute doses of sulphate of copper. ℞ Cupri sulphat., gr. j ; tinct. opii deodor., gtt. viij ; aquæ destil., ℥ iv. M. Sig. : *A teaspoonful every two, three, or four hours*, for a child from one to two years of age.

The sulphate of copper is a useful palliative astringent in the *diarrhœa of phthisis*. It should be combined with opium.

Kissel regards the salts of copper as curative in *pneumonia*, and the preparation which he prefers is the tincture of the acetate (Phar. Ger.). The mortality under this treatment was only 4·3 per cent. Ammoniated copper has been used recently with remarkable success in the treatment of *facial neuralgia*. It must be pushed (Féréol).

The salts of copper, especially the *cuprum ammoniatum*, are among the numerous remedies employed in the treatment of *epilepsy*, *chorea*, and *hysteria*. Successful results have, it is true, been obtained by the use of these remedies, but at the present time they are rarely employed.

EXTERNAL USES.—The salts of copper do not act very energetically on the unbroken integument. Applied to wounds they are astringent—that is, they combine with albumen, contract the tissues, and coagulate the blood. A crystal of sulphate of copper may be used *to arrest bleeding from small wounds*, e. g., from *leech-bites*. *Indolent ulcers with flabby granulations* can be stimulated to a renewed and more healthy activity by touching the affected surface with a crystal of sulphate of copper, or by frequent application of a solution (grs. ij—grs. x—℥ j). The following is an excellent injection in *gonorrhœa* after the acute stage : ℞ Cupri sulph., grs. iv ; morphinæ sulph., grs. viij ; liq. plumbi subacetat., ʒ j ; aquæ rosæ, ℥ iv. M. Sig.: *As an injection.* In that troublesome affection, *granular lids*, the sulphate of copper may be rubbed over the everted lid once a day with advantage. The application gives great pain, and is immediately followed by intense hyperæmia, which, however, subsides in a few hours, leaving the conjunctiva in much better condition than before.

In *scabies*, a solution of sulphate of copper (℥ j—Oj) has been used with great success, the lotion being applied after the crusts have been thoroughly removed with soap and water. An ointment of acetate of copper (grs. x—℥ j) is a very effective application in *herpes circinatus* (ringworm). The following formula has been recommended in *mentagra :* ℞ Cupri sulph., ʒ j ; zinci sulph., ℥ ss ; aquæ laur.-cerasi, ℥ jss ; aquæ destil. ad ℥ xvj. M. Sig.: *Lotion.* The acetate and carbonate of copper are very effective remedies in *tinea sycosis*. ℞ Cupri carb., ʒ ij ; adipis, ℥ j. M.

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Plumbum.—Lead. *Plomb*, Fr. ; *Blei*, Ger.

Plumbi Oxidum.—Lead oxide. Litharge. In small yellowish or orange-colored scales, insoluble in water, but almost wholly soluble, with slight effervescence, in dilute nitric acid. The solution is affected by potassa, like that of carbonate of lead in the same acid.

Emplastrum Plumbi.—Lead-plaster. Litharge and olive-oil.

Plumbi Acetas.—Lead acetate. Sugar of lead. In colorless crystals which effloresce on exposure to the air. It is dissolved by distilled water, with a slight turbidness, which is removed by the addition of vinegar. With this solution carbonate of sodium produces a white, iodide of potassium a yellow, and hydrosulphuric acid a black precipitate. Upon the addition of sulphuric acid, vapor is evolved, having the smell of vinegar. Dose, gr. ss—gr. v.

Liquor Plumbi Subacetatis. — Solution of lead subacetate. A colorless liquid of the specific gravity of 1·267. It is decomposed by exposure to the air, carbonate of lead being formed. When added to a solution of gum it occasions a dense white precipitate.

Liquor Plumbi Subacetatis Dilutus.—Diluted solution of subacetate of lead. (Solution of subacetate, 30 c. c. ; distilled water to make 1,000 c. c.)

Ceratum Plumbi Subacetatis.—Cerate of lead subacetate. (Solution of subacetate of lead, 200 grm. ; camphor cerate, 800 grm.)

Plumbi Carbonas.—Lead carbonate. A white substance in powder or pulverulent masses, insoluble in water, but soluble, with effervescence, in dilute nitric acid. Potassa added to the solution produces a white precipitate, which is wholly dissolved by an excess of the alkali. Used in the preparation of the unguent, and also applied topically.

Unguentum Plumbi Carbonatis.—Ointment of carbonate of lead. (Carbonate of lead, 10 grm. ; benzoinated lard, 90 grm.)

Plumbi Nitras.—Lead nitrate. In white, nearly opaque, octahedral crystals, permanent in the air, and of a sweet astringent taste. It is soluble in seven and a half parts of cold water, and in alcohol. Its solution is precipitated black by hydrosulphate of ammonium, white by ferrocyanide of potassium, and yellow by iodide of potassium.

Plumbi Iodidum.—Lead iodide. A bright-yellow, heavy, inodorous powder, fusible and volatilizable by heat, and soluble in 1,235 parts of cold and 194 parts of boiling water. A hot saturated solution, on cooling, deposits the salt in brilliant, golden scales.

Unguentum Plumbi Iodidi.—Ointment of iodide of lead. (Iodide of lead, 10 grm.; benzoinated lard, 90 grm.)

ANTAGONISTS AND INCOMPATIBLES. — Natural waters containing lime, sulphates, carbonates, carbonic acid, mineral acids and mineral salts, vegetable acids, alkalies, iodide of potassium, the vegetable astringents in general, albuminous solutions, and the preparations of opium, are incompatible. In cases of poisoning by acetate of lead, the proper antidotes are the sulphates of soda or magnesia, phosphate of soda, milk, and albuminous solutions. Emetics and the stomach-pump should be used.

SYNERGISTS.—Cold, digitalis, ergot, veratrum viride, and agents acting similarly, favor the influence of acetate of lead over the circulatory system. Copper, mercury, antimony, and remedies promoting waste, increase the depressing effects of lead on the nutrition of the body.

PHYSIOLOGICAL ACTIONS.—The acetate is astringent ; that is, it combines with albumen to form compounds, for the most part insoluble in water and in acids. All the salts of lead are more or less toxic. As the acetate, which is most frequently the preparation taken, has a sweetish taste, mistakes not unfrequently happen ; but the after-taste is decidedly astringent and slightly metallic. As the combination of the salts of lead with albumen takes place on contact, this action ensues in the mouth in part, and is completed in the stomach. Any part of the lead reaching the intestinal canal must be converted into the insoluble sulphide. A very large quantity of the acetate of lead is required to produce a fatal effect ; not less than an ounce. When swallowed in this quantity and retained, it produces intense gastric irritation, sometimes choleriform symptoms, numbness, paralysis, coma, collapse. Owing to the fact that so large a quantity of acetate of lead will be rejected by vomiting, cases of acute poisoning rarely terminate fatally, and are infrequent. On the other hand, chronic poisoning by lead is very common, owing to the use of cosmetics and hair-dyes containing lead, the use of food preserved in tin cans soldered with lead, and to the contamination of drinking-water. Very rarely is the acetate of lead so persistently used in medical practice as to produce toxic symptoms.

When lead is slowly introduced into the organism in small doses, the first symptoms usually observed are loss of appetite, failure of strength, more or less wasting, paleness of the face and of the integument generally, and constipation. The joints become the seat of rheumatoid pain ; there is dry colic, the pain of which is assuaged by pressure ; and the muscles of the abdominal parietes are also seized with neuralgia. At the same time the liver diminishes in size, the abdominal fat disappears, the intestines are contracted, the belly is drawn in toward the spinal column. Coincidently with the contraction of the liver, the skin assumes an icteroid hue, the conjunctivæ become yellow, and the urine is tinged with the biliary coloring matters. At this time may be observed the so-called "blue line" along the margin of the incisor teeth — a slate-colored line, probably due to a deposition of the sulphide of lead, and found only, according to the author's experience, in those not accustomed to the use of a toothbrush. The mucous membrane of the lips and mouth has often a bluish or slate-colored tint, and sometimes brownish pigment-deposits are seen on the lips near the teeth, and on the gums. Albuminuria may exist at this time, but it is commonly present further on in the history of these cases. Lead may cause that condition of hyperalbuminosis which eventuates in albuminous urine, but probably it in most cases hastens the development of changes in the kidneys already impending. As Garrod has conclusively shown, the use of lead, or its slow introduction through unknown channels, hinders the conversion of uric acid into urea, and favors the deposition of urate of soda about the joints: hence the arthritic pains which accompany the other symptoms of chronic lead-poisoning, and the intimate relation of the presence of lead in the organism and gouty attacks.

The symptoms thus far sketched are chiefly those due to the influence of the agent over the oxidation processes of the body in general. It is necessary now to consider the action of lead on the nervous system. Lead *gastralgia* is an early symptom, in part due to the fact that the metal acts directly on the nerves of the stomach, but it is also a symptom of the action of the poison on the central nervous system. Lead *arthralgia*, already referred to, is frequently an affection of the intra-muscular nerves, and has its seat more especially in the flexor muscles. The swelling of the joints and the joint-pains are doubtless due, as already explained, to the deposition of the urates in the joints themselves, but the term arthralgia is used to describe that form of pain about the joints produced by lead. Impaired sensibility to touch is also one of the phenomena of lead-poisoning. This *lead-anæsthesia* is found about the neck, chest, the forearms (their palmar face), hands, and fingers, and is symmetrically distributed on the two sides. Anæsthesia of the optic (*amaurosis*) is also a result of the direct action of lead, but dimness of vision and a sluggish pupil may also be due to the albuminuria which is so frequently present. *Paralysis* of the common extensors of the fingers and of the supinators, while the power of the flexors and pronators is much less diminished, constitutes that very striking symptom of lead-poisoning, "the drop-wrist." When the arms are raised the hands drop forward and to the palmar face of the forearm, from an inability of the extensors to hold them up. Paralysis may invade the laryngeal muscles, producing *aphonia*. Sometimes the paralysis has the hemiplegic form, and, still more rarely, the paraplegic. At the beginning of the paralysis, the muscular irritability is preserved, but it soon lessens, and is lost finally, so that the muscles cease to respond to the faradic current. For some time after the induction current fails to excite contraction, muscular movements may be obtained by a slowly-interrupted galvanic current.

Death may result from the saturnine cachexia, by the gradual failure of nutrition, and by the extension, finally, of the muscular paralysis to the muscles of respiration. Death may occur much earlier, by the development of those symptoms to which has been applied the term *lead-encephalopathy*—a form of disease characterized by delirium and convulsions, ending in fatal coma.

Lead is very fatal to the life of the fœtus, and women the subjects of the saturnine cachexia abort early, or produce stillborn children.

After death, lead is found in various organs of the body, and relatively in large amount in the brain. It is also largely deposited in the substance of the affected muscles and nerves, and the destruction of the Hallerian irritability, the disappearance of the striation and the granular condition of the nerves, are probably due to the direct action of the metal. Lead, also, like the other minerals, tends to accumulate in the liver; much of it is probably eliminated by the intestinal glands and skin, and some passes out by the kidneys.

The treatment of lead-poisoning is prophylactic and curative. Among the former are, personal cleanliness, frequent bathing, the use of sulphuric-acid lemonade, the habitual employment of milk in large quantity as a food, and the avoidance of all sources of contamination. Among the curative measures must be placed first, large doses of the iodide of potassium, purgative doses of Epsom salts, and sulphur-baths. The affected muscles should be early faradized to prevent atrophic changes. When they fail to respond to a faradic current, a slowly-interrupted galvanic current should be used, and after a time the faradic irritability may be recovered.

THERAPY.—Acetate of lead is one of the astringent remedies employed to arrest *hæmatemesis*. It is more especially adapted to the vomiting of blood which accompanies *gastric ulcer*. This salt exercises a favorable influence over the course and progress of gastric ulcer; it allays pain and local inflammation, and modifies the ulcerated surface. In *chronic gastric catarrh* with *gastralgia* and *pyrosis*, it has given great relief. Notwithstanding the chemical incompatibility, it may be advantageously combined with morphine in painful stomach-affections. The most frequent use of the acetate of lead in gastro-intestinal disorders is in the treatment of the various forms of *diarrhœa*. It is an excellent remedy in the *summer diarrhœa of children*. ℞ Plumbi acetat., grs. viij; acid. acetic., gtts. vj; tinct. opii deodor., gtts. iv; aquæ destil., ℥ j. M. Sig.: A teaspoonful every two, three, or four hours for a child two years of age. In *choleraic diarrhœa*, acetate of lead is one of the most useful astringents: ℞ Plumbi acetat., grs. xxiv; pulv. opii, grs. xij; pulv. camphoræ, ʒ ss; sacch. alb., q. s. Ft. pulv. no. xii. Sig.: One powder every hour or two. It is sometimes preferable to administer the acetate of lead in solution, when the formula above given for children may be used in corresponding dose for adults. Probably, the most generally successful remedy for the *diarrhœa of phthisis* is a pill containing equal parts of acetate of lead and opium. The *diarrhœa of typhoid* may also be restrained by acetate of lead and opium; but generally bismuth is more suitable than acetate of lead. In *acute* and *chronic dysentery* lead is often a useful astringent. Enemata of lead and morphine (℞ Plumbi acetat., grs. iv; morphinæ acetat., gr. ss; aquæ fervid., ℥ j) allay the tenesmus of *acute dysentery*. Enemata of corresponding strength to age, of the same composition, are very useful in the *cholera infantum* of children.

Although the salts of lead undergo important chemical changes in the intestinal canal, and are probably very much modified in composition before they enter the blood, yet there is no doubt about their power to affect remote parts. The value of acetate of lead in various forms of *hæmorrhage* has been attested by an immense clinical experience. Thus, in *hæmoptysis*, it is a most useful hæmostatic. Careful observations on a case of severe and protracted pulmonary hæmorrhage demonstrated that five grains of the acetate, every three hours, exercised a remarkable influence over the arterial tension and the action of the heart. Its effects are similar to those of digitalis: it slows the action but increases the power of the heart, while at the same time it elevates the tension of the arterioles. The astringent is, however, a dynamical and not a chemical action, doubtless. There is, therefore, a fitness in the prescription of Oppolzer for *caseous pneumonia:* ℞ Inf. digitalis, ℥ iv; plumbi acetat., ℈j; tinct. opii, ʒ j. M. Sig.: A tablespoonful twice a day. A similar combination is serviceable in *hæmoptysis:* ℞ Plumbi acetat., ℈ij; pulv. digitalis, ℈j; pulv. opii, grs. x. M. Ft. pil. no. xx. Sig.: One every four hours.

By virtue of its astringent action acetate of lead restrains secretion, and hence its utility in *bronchorrhœa.* It is also serviceable in *humid asthma* and *whooping-cough.*

Formerly acetate of lead was used to quiet the action of the heart in *hypertrophy*, and to favor coagulation of the blood in the case of *internal aneurism.* It might often be usefully employed in these affections now.

In prescribing the preparations of lead for internal use, the danger of producing *plumbism* should not be overlooked. When it is used for any considerable period, the gums should be frequently inspected, and on the slightest appearance of a blue line, or on the occurrence of constipation and abdominal pain, the remedy should be at once discontinued.

EXTERNAL APPLICATION OF LEAD PREPARATIONS.—The uses of lead preparations for external diseases are numerous and important. An excellent application to *burns* is white-lead paint—carbonate of lead and linseed-oil. This may be objectionable when the surface is very large, lest a dangerous amount of absorption take place, but for burns of small extent it is safe and gives great relief. The surface of the burn is thickly coated with the paint. Lead-lotion (*liquor plumbi subacetatis dilutus*) is a good application to *eczema* when there is much weeping. The following ointment has been recommended in this affection: ℞ Plumbi acetat., ℥ ss; camphor. pulv., grs. xv; ol. amygdal., ℥ ij; ceræ flavæ, ℥ j. M. Ft. cerat. An excellent formula for *eczema*, when there are great heat and redness, and profuse discharge, consists of liquor plumbi subacetatis, ℥ j; glycerinæ, ℥ ss; and cherry-laurel water, ℥ iijss. The following formula is recommended by Fox in *eczema and lichen:* ℞ Acid. nitrici dil., ʒ ss; plumbi acetat., grs. v; aquæ, ℥ vj. M. In *erythema* the carbonate of lead is used with advantage: ℞ Plumbi carb., grs. iv; glycerinæ, ʒ j; cerat. simplicis, ℥ j. M. In *impetigo* the following: ℞ Plumbi acetat., grs. xv; acid. hydrocyan. dil., ♏ xx; alcoholis, ℥ ss; aquæ, ℥ vss. M.

Lead lotions are much used to cure *muco-purulent and purulent discharges from the ear, the vagina, and the urethra.* They may be employed at any stage, and the existence of inflammation does not contraindicate their use. The following is a useful formula for *gonorrhœa:* ℞ Liq. plumbi subacetat. dil., ℥ iv; zinci sulphat., grs. viij. M. Sig.: *As an injection.* A chemical change, of course, takes place, but clinical experience is in favor of the combination.

The ointment of the iodide of lead is often a useful application to *enlarged lymphatic glands* and to *enlarged spleen.* It is also employed with benefit in cases of *chronic eczema, porrigo,* and *psoriasis.*

A solution of the nitrate of lead in pure glycerin (grs. x— ℥ j) is an effective application to *fissured nipples.* It need hardly be remarked that the nipple should be well washed before the child is permitted to suck. Nitrate of lead in form of powder, dusted over the unhealthy granulations, gives great relief, and hastens the healing of *onychia.*

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Zincum.—Zinc. *Zinc*, Fr.; *Zink*, Ger.

Zinci Oxidum.—Zinc oxide. A yellowish-white powder, insoluble in water, but soluble in dilute sulphuric and muriatic acids without effervescence. The solutions, when neutral, yield white precipitates with ferrocyanide of potassium and hydrosulphate of ammonium. Dose, gr. ss—grs. v.

Zinci Carbonas Precipitatus.—Precipitated zinc carbonate. A light, white powder, odorless and tasteless, and insoluble in water or alcohol.

Ceratum Zinci Carbonatis.—Cerate of carbonate of zinc. (Not official.) (Carbonate, ℥ ij; ointment, ℥ x.)

Zinci Sulphas.—Zinc sulphate. In colorless crystals, which effloresce on exposure to air. It is soluble in water, and the solution affords white precipitates with ammonia, chloride of barium, ferrocyanide of potassium, and hydrosulphate of ammonium. The precipitate thrown down by ammonia is wholly soluble in an excess of the alkali. Dose, gr. ¼—gr. vj.

Zinci Acetas.—Zinc acetate. In micaceous crystals, which effloresce in a dry atmosphere. It is soluble in 2·7 parts of water, and its solution yields white precipitates with ferrocyanide of potassium and hydrosulphate of ammonium. The salt is decomposed by sulphuric acid, with the escape of acetous vapors. Dose, gr. ss—gr. ij.

Liquor Zinci Chloridi.—Solution of zinc chloride. An aqueous solution, containing about 50 per cent by weight of the salt.

Zinci Chloridum.—Zinc chloride. A white deliquescent salt, wholly soluble in water, alcohol, and ether. Its aqueous solution yields with nitrate of silver a white precipitate, insoluble in nitric acid. (These preparations are for external use only.)

Zinci Valerianas.—Zinc valerianate. A white anhydrous salt, in the form of pearly scales, having a faint odor of valerianic acid, and a metallic styptic taste. It dissolves in one hundred parts of water, and in forty of alcohol of the specific gravity of 0·833. Dose, gr. ¼—gr. j.

Unguentum Zinci Oxidi.—Ointment of zinc oxide. (Zinc oxide, 200 grm.; benzoinated lard, 800 grm.)

ANTAGONISTS AND INCOMPATIBLES.—Lime-water, the alkalies and their carbonates, nitrate of silver, and the vegetable astringents, are incompatible with zinc-salts. The acetate of lead is also incompatible, but a solution containing sulphate of zinc and acetate of lead, notwithstanding the double decomposition which ensues, is an effective injection in gonorrhœa. With valerianate of zinc, acids, many of the metallic salts, soluble carbonates, and vegetable astringents, are incompatible. The antidotes to be used in cases of poisoning by the zinc-salts are lime-water, mucilaginous drinks, milk, tannic acid, the carbonated alkalies, common soap, etc.

SYNERGISTS.—The mercurial, silver, antimonial, and copper preparations favor the action of the zinc-salts.

PHYSIOLOGICAL ACTIONS.—The preparations of zinc are active in proportion to their solubility and power of diffusion. The chloride, the sulphate, and the acetate, are the most active, and in the order in which they are placed ; the carbonate and the oxide being insoluble, have very feeble diffusive power, and possess consequently very slight activity. The chloride is a very active escharotic. Applied to the denuded integument, it sets up decided inflammation, and produces an intense burning pain, followed by sloughing. Owing to its great affinity for water and power of combination with albumen, it penetrates deeply and widely, and the eschar which it produces is thick, hard, and white. The dried sulphate of zinc (deprived of its water of crystallization by heat) is also feebly escharotic when applied to an open wound. Solutions of the sulphate and acetate act locally as *astringents* by combining with albumen.

The soluble salts of zinc have a styptic metallic taste, which is very disagreeable. The sulphate of zinc is a very prompt and efficient emetic, acting without much preliminary nausea, and without much constitutional depression. It is a *specific emetic ;* it acts to produce emesis when injected into the veins. Long-continued use of the sulphate, even in small medicinal doses, may excite ulceration of the mucous membrane. The oxide and carbonate, although insoluble and inactive, slowly produce systemic effects. The chloride is a powerful irritant poison, causing heat and a sense of constriction of the throat, a strong metallic taste, burning at the stomach, nausea, vomiting, great depression of the pulse, coldness of the surface, cold sweat, cramps of the legs, etc. The mind is unaffected. In a few instances nervous symptoms have followed, besides the cramps, and in one notable case there was loss of the senses of taste and smell.

All of the salts of zinc, when long continued, may produce a train of symptoms not unlike those caused by lead, viz., emaciation, pallor, loss of strength, constipation and colic, muscular weakness and trembling, paralysis, etc. The oxide in large doses, and used for a long period, has produced wasting, a fetid breath, gastro-intestinal catarrh, weakness, and feeble mind.

The zinc-salts most probably exist in the blood in the form of albuminate, and in close relation to the red blood-globules. They manifest much less tendency to accumulate, and are excreted much more rapidly than mercury, lead, and copper. They diffuse out of the blood chiefly by the liver and intestinal glandular apparatus, and are found in great quantity in the fæces. To a slight extent they are also excreted by the kidneys.

THERAPY.—The sulphate of zinc is much employed as an *emetic* in cases such as *narcotic poisoning*, where prompt and efficient action is necessary. Six grains will generally prove sufficient. It may be repeated every fifteen minutes, well diluted with water, until emesis occurs. It was formerly much employed as an *emetic* in *croup*, but now tartar-emetic, but especially the subsulphate of mercury, is preferred.

The oxide of zinc is an excellent remedy for *gastralgia*. It is indicated also in the following state of things: *pain after taking food, nausea, intestinal pain, succeeded by prompt alvine discharges*, the fæces being made up largely of undigested food. From five to ten grains mixed with aromatic powder and combined with morphine, if need be, may be given before each meal. In the *summer diarrhœa of children*, it is a very efficient remedy. It may be administered with bismuth and pepsin. ℞ Bismuthi subnitrat., ʒj — ʒij; pepsinæ sacch. (Sheffer's), ʒss; zinci oxidi, grs. vj—grs. xij. M. Ft. pulv. no. xii. Sig.: *One powder every four to six hours.* In the *chronic diarrhœa* both of children and adults the oxide of zinc (from two to ten grains) is serviceable under the same circumstances in which bismuth is presumed to be indicated, but it is a less pleasant remedy in action than the latter. The sulphate (gr. ss—grs. ij) often gives great relief in that form of *dyspepsia* which is the cause of *oxaluria*. In small doses, the sulphate, like most of the mineral remedies of this group, increases for a time the appetite and digestive capacity, but this effect is soon succeeded by gastro-intestinal catarrh, nausea, and loss of appetite. The sulphate, as well as the oxide, is an astringent; it arrests the peristaltic movements and causes constipation, and is therefore an appropriate remedy in *chronic diarrhœa* and *chronic dysentery*. In its action and results it is similar to but less efficient than sulphate of copper. It may be combined with opium and ipecacuanha: ℞ Zinci sulphat., pulv. opii, pulv. ipecac., āā grs. xij. M. Ft. pil. no. xij. Sig.: One pill three or four times a day.

The zinc preparations possess undoubted efficacy in certain disorders of the thoracic organs. The *night-sweats of phthisis* are often prevented by a pill of oxide of zinc and extract of belladonna (three grains of the former and half a grain of the latter) given at bedtime. The zinc is serviceable without the belladonna, but the combined action is more efficient. The sulphate of zinc, by virtue of its astringency, has been prescribed in *bronchorrhœa*, but other agents are now preferred. The oxide of zinc is a serviceable *prophylactic* against the recurrence of the attacks of *spasmodic asthma*. It is also one of the numerous remedies which has been used with a varying degree of success in *whooping-cough:* ℞ Zinci oxidi, ʒj; ext. belladonnæ, grs. v.

M. Ft. pil. no. xx. Sig.: *One pill three times a day* as a prophylactic for asthma, and as a remedy for whooping-cough. The sulphate of zinc (gr. ¼—gr. j) and extract of belladonna (gr. ⅙—gr. ss) may be used in combination for the relief of the same cases. It is highly probable that the sulphate of zinc, being more soluble, is much more efficient in the treatment of these neuroses of the digestive organs than the oxide.

The preparations of zinc exert an influence upon the nervous system which has been and is called *antispasmodic*. In certain disorders of the nervous system, of which the chief manifestations are *spasm* and *convulsion* (clonic), they are sometimes very serviceable. Much has been said for and against the oxide of zinc as a remedy for *epilepsy*. A few cases are improved by it; in the great majority it fails utterly. When favorable, it acts by allaying irritability of the terminal filaments of the pneumogastric, and probably also by removing a diseased state of the gastric mucous membrane. *Epileptiform vertigo* and *epileptiform angina pectoris*, when they arise (as they not unfrequently do) from gastric disorder of some kind, are sometimes cured by the oxide of zinc. The so-called *nervous headache* of hysterical women, *nervous cough*, and *aphonia*, due to uterine and ovarian irritation, are often relieved by the valerianate of zinc. Sulphate of zinc is one of the numerous remedies for *chorea*, acting in a manner similar to arsenic, but inferior to this agent in curative power. In *neuralgia* due to reflex irritation from the female pelvic organs, the preparations of zinc, notably the valerianate, are often extremely beneficial. ℞ Zinci valerianat., ℈j; ext. gentianæ, ℈j; ext. nucis vom., grs. v. M. Ft. pil. no. xx. Sig.: *One pill three or four times a day*. In *chronic alcoholismus*, to relieve the trembling, to diminish the appetite for strong drink, and to relieve the gastric catarrh, the oxide of zinc is very useful: ℞ Zinci oxidi, ʒj; piperin., ℈j. M. Ft. pil. no. xx. Sig.: *One pill three or four times a day*.

EXTERNAL USES.—The interstitial injection of a solution of zinc chloride has lately been brought forward as a remedy for *pulmonary tuberculosis*, and, it is alleged, with a large measure of success. Lannelongue was the first to practice this expedient, and he continues to advocate it as a valuable curative agent. The method consists in injecting into the pulmonary parenchyma a solution of zinc chloride of the strength of 1 to 50 to 20. It causes no injury to the lung tissues, and it is not painful. The needle is carried into the area occupied by the disease and three drops of the solution are slowly injected.

An excellent caustic for the destruction of *lupus*, *epithelioma*, and *unhealthy ulcers* is the *dried* sulphate of zinc, which may be freely dusted over the affected surface. A superficial slough forms, the separation of which may be aided by a poultice. The most efficient escharotic consistent with safety is the chloride. No danger is to be apprehended from its absorption, and the strength of the application may be easily regulated. For the destruction of *malignant growths*, chloride of zinc is applied of varying strength, by the admixture of different proportions of flour, or better, of powdered althea-root, so as to form a paste, sufficient water being added. One part of the chloride to two, three, four, or five parts of flour are the proportions advised by Dr. Canquoin. Instead of flour, the chloride may be mixed with anhydrous sulphate of lime. A very convenient and useful mode of applying chloride of zinc is, to mix it, while in a finely-powdered state, with its weight of gutta-percha melted with as little heat as possible. The mixture may be molded into any desired shape. The so-called "caustic arrows" are nothing more than chloride-of-zinc paste, dried and cut into arrow-like slips. These are inserted into the malignant growth, usually at its base, in order to separate it from the healthy tissues.

The salts of zinc are useful applications to certain forms and stages of skin-diseases. In *eczema*, during the secretory stage, the following may be used: ℞ Zinci oxidi, ʒ ij ; glycerinæ, ℥ ij ; liq. plumbi subacetat., ʒ jss ; aquæ calcis ad ℥ vj. M. Sig.: *Lotion* (Fox). This formula is serviceable also in *impetigo* and *herpes*. An excellent *absorbent powder for excoriated surfaces* is the following: ℞ Corn-meal, finely sifted, ℥ iv ; oxide of zinc, ℥ j ; iris powder, ℥ ss ; oil of almonds, gtts. x. M. The following is recommended by Neumann in *seborrhœa*, when there is inflammation: ℞ Zinci oxidi, ʒ j ; plumbi carbonat., ʒ j ; cetacei, ℥ j ; ol. olivæ q. s. ft. ung. Sig.: *Ointment.* In *erythema*, *intertrigo*, and *eczema*, the following lotion is useful: ℞ Aluminis, ℈ j ; zinci sulph., grs. x ; glycerinæ, ʒ j ; aquæ rosæ, ℥ iv. M. Sig.: *Lotion.* For *erythema* and *herpes*, the following may also be used: ℞ Zinci acetat., grs. ij ; aquæ rosæ, ʒ j ; ung. aquæ rosæ, ℥ j. M. Sig.: *Ointment.* The ointments of the oxide of zinc and the cerate of the carbonate are excellent applications in many of the cutaneous affections above named.

Probably the most efficient means for treating *gonorrhœa* consists in the use of a weak zinc-injection frequently repeated. ℞ Zinci chloridi, gr. j ; aquæ rosæ, ℥ iv—℥ viij. M. Sig.: *As an injection.* ℞ Zinci sulph., grs. viij ; aquæ rosæ, ℥ viij. M. Sig.: *As an injection.* After the acute symptoms have subsided, the following injection is very effective: ℞ Zinci sulphat., plumbi acetat., āā grs. viij ; ammoniæ muriat., aluminis, āā grs. iv ; aquæ rosæ, ℥ j. M. Sig.: *As an injection.*

The sulphate of zinc is very much prescribed by the ophthalmologists in *conjunctivitis*, *otorrhœa*, etc. It is usually associated with morphine and atropine. ℞ Zinci sulphat., grs. ij—grs. viij ; morphinæ sulph., grs. ij—grs. iv ; atropinæ sulph., gr. ss—gr. j ; aquæ rosæ, ℥ j. M. Sig.: *For the eye.*

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Antimonium.—Antimony. *Antimoine*, Fr. ; *Antimon*, Ger.

Antimonii et Potassii Tartras.—Antimony and potassium tartrate. Tartar-emetic. In transparent crystals which become white and opaque on exposure to the air. It is wholly soluble in twenty parts of water. The solution yields no precipitate with chloride of barium, or, if very dilute, with nitrate of silver. Hydrosulphuric acid causes an orange-red precipitate. A solution containing one part in forty of water is not disturbed by an equal volume of a solution of eight parts of acetate of lead in thirty-two of water and fifteen of acetic acid. Dose, gr. $\frac{1}{12}$—gr. ij.

Vinum Antimonii.—Wine of antimony. (Tartrate of antimony and potassium, 4 grm. ; boiling distilled water, 65 c. c. ; alcohol, 150 c. c., and white wine, q. s. to make 1,000 c. c.) Nearly two grains to the ounce. Dose, ♏ v—ʒ ij.

Mistura Glycyrrhizæ Composita.—Compound glycyrrhiza mixture. (Brown mixture. Contains extract of glycyrrhiza, paregoric, nitrous ether, and wine of antimony.) Dose, a tea- to a tablespoonful.

Syrupus Scillæ Compositus.—Compound sirup of squill. Hive-sirup. (Squill, seneka, tartar-emetic. Contains about three fourths of a grain of tartar-emetic to the ounce.) Dose, ♏ v—ʒ j.

Antimonii Oxidum.—Antimony oxide. A grayish-white powder, insoluble in water, but readily and wholly soluble in muriatic or tartaric acid. Dose, gr. j—gr. iij.

Antimonii Sulphidum Purificatum.—Purified antimony sulphide. A dark-gray powder, odorless and tasteless, and insoluble in water or alcohol. Dose, gr. $\frac{1}{4}$—gr. j.

Antimonii Sulphuratum.—Sulphurated antimony is a reddish-brown powder, insoluble in water. Dose, gr. j—gr. v.

Pilulæ Antimonii Compositæ.—Compound pills of antimony. Plummer's pills. They are composed of sulphurated antimony, calomel, and guaiac, and each pill contains a little more than a half-grain of calomel. Besides the utility of the combination, the name is convenient when prejudices exist against the use of the mercurial.

In the remarks which follow, tartar-emetic is the only antimonial preparation referred to, unless otherwise stated. None of the other preparations are employed by modern physicians.

ANTAGONISTS AND INCOMPATIBLES.—Tannic and gallic acids, and vegetable infusions containing them, form an insoluble tannate, and are therefore incompatible. Alkalies and the salts of lead decompose tartar-emetic. It follows that the proper antidotes to poisoning by tartar-emetic are tannic acid and substances containing it. Opium, alcohol, ether, etc., and the antispasmodics generally, are physiologically antagonistic.

SYNERGISTS.—The mineral substances of this group promote the action of the antimonials; also the emetics and cathartics, and depressing remedies generally, as veratrum viride, etc.

PHYSIOLOGICAL ACTIONS.—Tartar-emetic has a sweetish, styptic, and metallic taste. In small medicinal doses, it excites a sensation of warmth in the stomach, followed by nausea, increased flow of saliva and buccal mucus, an abundant secretion of the gastric and intestinal glandular apparatus, and also of the liver and pancreas. In somewhat larger doses—a half-grain to one or two grains—it excites vomiting, first of the contents of the stomach, then of gastric mucus, and afterward of mucus and biliary matters. The alvine dejections are more fluid and increased in number, and consist at first of fluidified fæces; afterward they are made up of a colored liquid, in which there are present biliary matters and some fæces; and, finally, there appears only a colorless or whitish liquid, having flocculi of epithelium floating in it, and bearing a striking resemblance to the "rice-water discharges" of cholera.

The gastro-intestinal symptoms are accompanied by systemic disturbance—paleness of the face, coldness of the surface (sometimes preceded by a very temporary rise of temperature), irregularity and feebleness of the pulse, and great nervous and muscular prostration. When the quantity is sufficient to cause lethal symptoms, they are as follows: epigastric pain, vomiting and purging, shrunken features, cold breath, cyanosis, arrest of the urinary secretion, aphonia, cramps—the assemblage of symptoms belonging to the collapse of cholera.

Tartar-emetic, when used in considerable medicinal doses, sets up an irritation of the fauces followed by aphthous ulcerations, which continue along the œsophagus to the stomach, and are accompanied by salivation and painful deglutition.

Applied to the skin by friction, tartar-emetic excites a follicular inflammation, succeeded by a papule, a vesico-pustule, a surrounding inflammation with indurated base, a central umbilication, and finally desiccation, terminating in a brownish scab. These antimony-pustules are very similar to those of vaccine or variola.

When applied to the skin or injected into the veins, tartar-emetic is absorbed, and manifests a selective action on the gastro-intestinal mucous membrane, causing the same irritant effects as are produced by its stomach administration. It is, therefore, a specific, and not a merely irritant emetic.

Tartar-emetic readily diffuses into the blood. In what form, unless as an albuminate, it exists in the blood, is not understood. It diminishes the number and force of the arterial pulsations, and rapidly lowers the blood-pressure. The pulse may fall from 72 to 40, but, according to Hirtz, rarely is the number reduced more than 6 to 10 per minute. In the healthy subject, the normal temperature, even when a full medicinal dose has been administered, remains unaffected as to the trunk, but it may be reduced in the extremities. In fevers and inflammations, a considerable reduction of temperature may take place, and the same result has been noted in the physiological state when the quantity of tartar-emetic has been sufficient to produce choleriform symptoms.

In man delirium, and in animals paralysis, motor and sensory, but without impairment of muscular contractility, have been observed from lethal doses of tartar-emetic.

Tartar-emetic promotes waste and hastens the elimination of the products of waste—the excretion both of carbonic acid and of urea being greatly increased by it.

The antimonial salts are found in the blood, in the liver, and other viscera, and are excreted by the bile, the milk, the perspiration, and the urine. It is, doubtless, also largely excreted by the intestinal glandular apparatus, as is the case with the metals generally.

If tartar-emetic is administered in small doses, and the quantity be gradually increased, the nauseating effects of the drug may be entirely prevented. When emetic doses even are continued in some subjects, this effect finally ceases, and the drug is borne without producing any gastric symptoms. To this state has been applied the term *tolerance*, by the contra-stimulant school of practitioners. It must not be lost sight of, that this tolerance, on the part of the stomach, of large doses does not mean an indifference to the action of the remedy, but very serious and profound anatomical alterations may result.

THERAPY.—Tartar-emetic was, formerly, much more frequently prescribed than at present as an *emetic* in cases of *indigestion* characterized by a coated tongue, loaded stomach, and anorexia (*l'embarras gastrique*). It is sometimes used as an emetic in cases of *narcotic poisoning*, but sulphate of zinc is preferable. It was formerly used as an emetic in the first stage of *typhoid and other fevers*, but, notwithstanding this practice is frequently followed by good results, it is now rarely pursued. If emesis is desirable in these cases, a less irritating and depressing emetic should be used.

In *croup* tartar-emetic is an efficient emetic, but it must be used with caution, owing to the great depression which it produces, and the fatal result which has occurred in many instances. It is not a suitable remedy for infants and very young children. The compound sirup of squills is a domestic remedy for croup, but the incautious use of this has proved fatal. Tartar-emetic is used in *laryngismus stridulus* to produce emesis and consequent relaxation of the muscles of the larynx, and in *true croup* to cause the expulsion of the false membrane. The yellow subsulphate of mercury is safer and quite as effective.

Tartar-emetic is an excellent remedy in the first stage of *acute catarrh, nasal, pharyngeal, and bronchial.* It is most efficient in the first stage, when the mucous membrane is dry and swollen. It promotes secretion, diminishes fever, induces diaphoresis, and hastens the elimination of inflammatory products. In these cases, from one twentieth to one twelfth of a grain is usually a sufficient quantity, for it is not necessary that nausea be excited. When cough is violent, a little opium may be added to the prescription. ℞ Antimonii et potassii tart., gr. ss; morphinæ acetat., gr. ss; aquæ, ℥ ij. M. Sig.: *A teaspoonful every hour or two.* In *acute bronchitis,* when the cough is dry and hoarse, this agent is useful, and small doses (one sixteenth of a grain), frequently repeated, are more serviceable than large doses at longer intervals.

Formerly, under the influence of the contra-stimulant school, tartar-emetic was given in large doses in *pneumonia.* It was sought to establish *tolerance* at an early period, and to administer the largest doses which could be borne. The comparative results of this method of treatment and of the expectant and restorative plans demonstrate the impropriety of the tartar-emetic treatment, and it is now abandoned. It is true that small doses of tartar-emetic, by increasing the action of the skin, kidneys, and intestinal canal, may exert a favorable influence over the temperature and diminish the plasticity of the exudation; but even small doses must be employed with care, lest a depression should be induced which may interfere seriously in the natural course of a disease which is self-limited and has its period of crisis.

Tartar-emetic gives great relief in *spasmodic asthma when the bronchial secretion is deficient,* and in those cases brought on by an overloaded stomach. In the former case small doses frequently repeated until very slight nausea is produced, and in the latter emetic doses, are necessary. The following is a useful form of expectorant in the acute inflammatory affections of the air-passages: ℞ Antimonii et potassii tart., gr. j; ammonii muriat., ℈iv; ext. glycyrrhizæ, ℈j; morphinæ muriat., gr. j; syrup. tolutan., aquæ lauro-cerasi, āā ℥j. M. Sig.: A teaspoonful every two, three, or four hours.

The ointment of tartar-emetic was formerly much employed to produce *pustulation of the chest* in the more *chronic pulmonary diseases.* This painful and disfiguring form of counter-irritation has passed out of use. To produce a crop of variolus-like pustules on the skin does not cause a morbid process like caseous pneumonia or tuberculosis to cease its ravages; on the contrary, such extensive suppuration in the skin rather favors the development of these diseases.

A combination of tartar-emetic and opium is a serviceable *hypnotic* in some cerebral disorders. These remedies appear to be most useful when *wakefulness and delirium are due to cerebral congestion*, and in those subjects who become excited and wakeful from the use of opium alone. In the *active delirium and wakefulness of typhoid fever*, tartar-emetic and opium are prescribed: ℞ Antimonii et potassii tart., gr. j—grs. ij; morphinæ sulph., gr. jss; aquæ lauro-cerasi, ℥ j. M. Sig.: *A teaspoonful every two, three, or four hours.* In *delirium tremens*, when the same conditions exist, the same combination may be prescribed. Since the introduction of chloral and bromide of potassium, however, the use of these drugs for the purposes just indicated has been much restricted.

In acute inflammatory and febrile diseases, minute doses of tartar-emetic (gr. $\frac{1}{16}$), frequently repeated, render an incontestable service. *Typhoid, typho-malarial, and remittent fevers, acute rheumatism, erysipelas*, etc., are maladies thus benefited. This remedy is, of course, contraindicated when there is much irritability of the stomach and intestinal canal. *At the outset of fevers* it was formerly the custom to prescribe an active emetic, and good results certainly followed this practice. The author believes that he has frequently seen impending attacks of *malarial fever* aborted by emetic doses of antimony and ipecac. Free emeto-catharsis moderates the severity of *remittent fever* in robust subjects when produced in the incipiency of this disease, and also puts the mucous membrane in a better state for the disposition of medicines and food.

Before the days of anæsthesia tartar-emetic was much used to relax the *muscular system* for the *reduction of dislocations*, to *facilitate the taxis in strangulated hernia*, to *relax rigid os and perineum in labor*, etc., but it is now no longer employed for these purposes.

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Cadmium.—Cadmium. *Cadmium*, Fr.; *Kadmium*, Ger. (Not official.) *Cadmii Sulphas.*—Sulphate of cadmium.

Action and Uses.—There is a strong resemblance—an identity of action, indeed—between zinc and cadmium, except that the latter is the stronger. Cadmium has a decidedly caustic and astringent taste; it is powerfully nauseant and emetic, producing great depression of the powers of life. Locally the effects are those of an irritant poison, and the systemic effects correspond; although there are produced such cerebro-spinal symptoms as coma and convulsions. This agent is not administered internally, the preparations of zinc being preferred for all purposes to which cadmium might be applied as a remedy.

In ophthalmic practice, cadmium seems to be much esteemed as a *collyrium*. It is held to possess special powers in causing absorption of *opacities of the cornea:* ℞ Cadmii sulph., grs. ij; aquæ rosæ, ℥ j. M. Sig.: *Collyrium*. A solution of the same strength is said to be an excellent local application in *otorrhœa*. There is no doubt that cadmium is an efficient injection in *gonorrhœa;* but it is important in the application of this, as of so many other astringent remedies, that it be not too strong—one grain of cadmium sulphate to four ounces of water being sufficient in most cases.

An ointment of cadmium is used somewhat by French physicians, in the treatment of external affections. For this purpose we may direct ten grains of the sulphate to be intimately incorporated with an ounce of simple ointment.

Strontium and its Salts.—*Strontii Bromidum.* — Strontium bromide. Colorless, transparent, hexagonal crystals, odorless, and having a bitter, saline taste. Very deliquescent. Soluble in 1·05 parts of water at 59° Fahr. (15° C.), and is readily soluble in alcohol. Dose, gr. v—ʒ j.

Strontii Iodidum.—Strontium iodide. Colorless, transparent, hexagonal crystals, and having a bitterish, saline taste. Soluble in 0·6 part of water at 59° Fahr. (15° C.). Also soluble in alcohol. Dose, gr. v—ʒ ss.

Strontii Lactas.—Strontium lactate. A white, granular powder or crystalline nodules, odorless, and having a slightly bitter, saline taste. Soluble in about 4 parts of water at 59° Fahr.; soluble in alcohol. Dose, gr. v—ʒ ss.

Antagonists and Incompatibles.—As the salts of strontium form precipitates with solutions of the sulphates and carbonates of soda, potassa, and calcium, these are incompatible. The iodides and bromides are not incompatible with the same salts of the alkalies. As the salts of strontium are soluble in alcohol, they can be prescribed with alcoholic tinctures.

Synergists.—The iodide and bromide of strontium promote the action of corresponding bases.

PHYSIOLOGICAL ACTIONS.—According to Laborde, who has made the most elaborate investigation of the actions of strontium, it is a non-toxic substance, and may be given in considerable quantity without causing any disturbance of a local or systemic character. Most of the salts, except the chloride, which appears to be innocuous, rather improve the appetite, promote the activity of the assimilation, and increase the body weight. The phosphate, however, more especially is a reconstituent—an agent having the power to increase the nutritive energies. The iodide and bromide of strontium have properties analogous to the corresponding salts of the alkaline bases, but they are more easily borne by the gastro-intestinal organs. The iodide possesses resolvent, discutient, or alterant properties. The bromide acts as a sedative to the nervous system. The evidence on this point is conclusive. If a solution of the bromide is injected into a member, it causes more or less complete anæsthesia, followed by infiltration and œdema. Administered in suitable doses, it causes somnolence, stupor, and paresis of the muscular system. It also lessens and finally extinguishes the reflexes, and it diminishes the sensibility of the mucous membrane. In fact, the bromide of strontium acts in a manner similar to the bromide of potassium, but it is far less depressing.

Most of the salts of strontium possess a diuretic property, but this is especially true of the lactate.

THERAPY.—In those disorders of the stomach characterized by acetic or lactic fermentation, loss of appetite, and nausea, the salts of strontium act favorably. When nausea of stomachal or cerebral origin is to be treated, the bromide is especially useful. When the nutrition is impaired because of loss of appetite and inactivity of the primary assimilation, great benefit may be expected from the use of the phosphate. Excellent results have been observed from the use of salts of strontium (nitrate and bromide) in the treatment of chronic rheumatism. Vulpian reported successful cases thus treated, in which the iodide of potassium and salicylate of soda had failed. He reports that under the action of the nitrate of strontium the swelling of the articulations rapidly subsided, that the local heat fell to normal, and the deposits of urates disappeared. This salt acts by promoting oxidation and increasing the excretion of urea.

The usual range of therapeutical activity exercised by the iodides of the other bases is equally the field of the iodide of strontium. The bromide is indicated and has been successfully used in the spasmodic neuroses, as *epilepsy*. Féré employed it in cases in which long use of the potash salt rendered the patient insusceptible to its action. He found it more useful, and he concludes hence that bromide of strontium should replace bromide of potassium in the treatment of that affection, especially when the latter has been long used.

It is especially as a remedy in Bright's disease that the salts of strontium are now used. When the symptoms of uræmia are due to insufficient urinary discharge, the lactate of strontium is indicated. According to Constantin Paul, the strontium salts give the best results in certain forms of nephritis—in parenchymatous nephritis, rheumatismal, gouty, etc.—but is not useful in interstitial nephritis. In these maladies from 8 to 10 grm. (ʒ ij — ʒ iij) of the lactate may be given daily. Dujardin-Beaumetz has also made use of the lactate in the treatment of albuminuria, and obtained, uniformly, a reduction in the quantity of the albumin passed, but without completely arresting its excretion. He concludes that while it affects favorably the most important symptom, it does not remove the pathological condition. It has, however, the advantage over the other remedies for albuminuria, in that it promotes the appetite and the primary assimilation, and can be made use of for longer periods.

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Cerium.—*Cerii Oxalas.*—Cerium oxalate. A white powder, insoluble in water, alcohol, and ether. Dose, two to five grains in pill form, as it is insoluble in the ordinary menstrua. It may be suspended in mucilage.

Sir James Simpson was the first to propose the use of oxalate of cerium to restrain *vomiting* arising from various causes, especially from *pregnancy*; and he brought forward many cases illustrative of its value. As he pointed out, it sometimes succeeds immediately, but usually the best effects are experienced after several days' use. The oxalate of cerium sometimes succeeds remarkably in vomiting due to serious organic lesions, as in cancer (Peters). It has been narrated in one case that four grains were administered every two hours until about 600 grains were taken. The good result which followed this large administration of the drug indicates that, in vomiting from similar causes, larger doses may be sometimes necessary to secure the best curative effects. In *chronic diarrhœa* cerium may take the place of bismuth.

In cases of *cough* associated with vomiting, excellent results have been obtained from the oxalate of cerium. It is probable that the cough is reflex in origin, the point of irritation existing in the terminal filaments of the pneumogastric in the gastric mucous membrane.

Uranium and its Salts.—*Uranii Nitras.*—Uranium Nitrate. Dose, gr. j to gr. v. It may be administered in pill form or in solution.

Actions and Uses.—According to Dr. West, Leconte was the first to observe that uranium nitrate given to dogs caused glycosuria. In 1888 Chittenden, and in 1889 Chittenden and Lambert, published their observations on the physiological action and toxic effects of this substance. In 1891, Cartier in his *Thèse de Paris* gave an elaborate account of the actions of the salts of uranium. Recently (1895) Dr. Samuel West, of St. Bartholomew's Hospital, London, has published a clinical study of the nitrate. There is unusual unanimity in the results of these studies. The various researches show that the salts of uranium are actively toxic. They cause, both in animals and in man, gastro-intestinal inflammation, a rapid decline in flesh and strength, and death by failure of respiration. Their poisonous effects are due to a destructive action on the epithelial structures of the body, on the arrest of the amylolytic and proteolytic processes whereby the ferment powers of pepsin and ptyalin are destroyed, on the combination with albumin, arresting its transformation, on the liver and kidneys, with the production of albuminuria and diabetes, and in the final production of uræmia. When the nitrate of uranium is injected into the blood in small quantity it causes rise of temperature, and increases the excretion of carbonic acid. In small doses, in what manner soever administered, it acts on the renal epithelium, and albumin appears in the urine. In larger doses, an important result is the occurrence of diabetes. The urine is otherwise changed, the phosphates increased, the chlorides lessened, peptones, acetone, lactic and butyric acids appear (Cartier). The quantity of albumin appears to be considerable, chiefly according to the amount given, and we may therefore assume according to the extent of the changes in the renal epithelium. After the albuminuria has occurred for a variable period, the glycosuria comes on, and this also has close relations with the amount taken. The uranium salts have not been detected in the urine, so that their effects must be exerted on the hepatic and pancreatic secretions, and the changes in the renal epithelium must be a part of a general process in which the albumin, or rather the protoplasm of the body, is rendered incapable of structural metamorphosis.

It is a peculiarity of uranium that small doses seem nearly, if not quite, as effectual as large ones. When its effects are produced and it is then discontinued, much larger doses than those originally administered are necessary to bring about the same results. Hence, it is suggested that uranium begets a certain tolerance by continued use.

Therapy.—The therapeutical uses of uranium have been deduced from its physiological actions. It is said that Dr. Hughes, of London, a homœopathic practitioner, was the first to make use of the nitrate as a remedy for *diabetes.* As, however, it acts by destroying the amylolytic and proteolytic ferments, and in consequence the conversion of glycogen is prevented, the law of similars can hardly be invoked to explain such a result. The first scientific application of nitrate of uranium to the treatment of diabetes was made by Dr. West, of St. Bartholomew's Hospital, London. He reports a number of cases in which marked improvement took place. He began with one or two grains of the nitrate twice daily after the principal meals. It should be freely diluted with water. He increased the dose slowly, and in some cases the quantity rose to as much as fifteen grains, without producing any troubles of digestion, nor did its prolonged administration bring on albuminuria. It does not appear that in any case the sugar disappeared entirely from the urine, but it was usually greatly reduced in amount, and at the same time there ensued great improvement in the general state.

As uranium causes albuminuria as well as diabetes, it would seem that we have in these salts a remedy for that state also. The albumin is present, because of an acute parenchymatous nephritis which it induces. It is much to be desired that further careful studies be made on this point.

Uranium Oxalate.

Uranium and Barium Oxide (Barium Diuranate).

Uranium and Strontium Oxide (Strontium Diuranate).

These are combinations of therapeutical agents hitherto used only in the arts, notwithstanding the individual components of them have been employed successfully in the treatment of disease.

Uranium oxalate occurs as a yellow powder, and is an active irritant poison. The initial dose should not be greater than one sixth of a grain. As oxalic acid has been administered successfully in the treatment of amenorrhœa, and as it causes albumin to appear in the urine, and as uranium has similar actions, inducing glycosuria as well as albuminuria, the combination is indicated in these affections, and probably also in other maladies of the genito-urinary apparatus.

Uranium and barium oxide is an orange powder, and is an irritant poison. The dose of this should not be greater at the outset than one fourth of a grain. As barium has a selective action on the vascular system, and uranium on the kidneys, the combination is indicated in acute renal diseases with elevated temperature.

Uranium and strontium have similar properties. The initial dose may be one grain, and this may be increased as required.

Authorities referred to :

Cartier, François. *Glycosuries toxiques et en particulier intoxication par le nitrate d'urane.* Thèse iv, 154 pp., Paris.

West, Dr. Samuel. *The British Medical Journal,* August 24, 1895.

METALLOTHERAPY.

Definition and Historical Development.—By the term *metallotherapy* is meant a curative method in which metals are applied to the affected area.

The influence of the noble metals over the bodily functions has been believed in from the remotest times within the historical period, and this belief has been acted on by many influential persons down to nearly our own era. The action of magnetic iron contributed to this mystical notion. Then came the wonder-working Mesmer. To the action of magnets was added that mysterious force evoked by the agencies employed by the Mesmerists. From such elements a pretended method of cure was elaborated, and a great many charlatans throve on the profits of the "system." Probably the most sustained success in this department of popular notions was effected by Dr. Perkins, of Connecticut, who invented a combination of metals arranged in the form of a cylinder, about six inches in length and two inches in circumference, which he called a *tractor*. Provided with a suitable handle, the tractor was slowly passed over the affected area, and the morbid process was drawn out or dispersed. Perkins's tractors excited great interest in this country, and in England an immense enthusiasm. An institution—known as the Perkinian Institute—was established in London, and many of the nobility and gentry resorted to it to be cured by the application of the tractors. In a book published by the son, there may be found many certificates of cures thus effected. These results are the less surprising when interpreted by the aid of subsequent developments from metallotherapy. Mesmer, Perkins, Hahnemann, appeared nearly simultaneously, and the theories of these three apostles of new creeds were developed by the revolutionary spirit of the times, rather than by original study, and were not the products of a systematic application to the truths of such science as then existed.

Metallotherapy, as now understood, had its origin in the experiments of Dr. Burq, which were first announced in a note addressed to the Academy of Sciences, and subsequently embodied in his thesis for the medical doctorate in 1851. He stated that a plate of metal—a silver coin, for example—applied to the skin, may remove the paralyses of motility or of sensibility occurring in hysteria ; that the same metal was not equally successful in all cases, and that idiosyncrasies exist, so that in respect to each individual there is a special metal, active and curative. In one subject it may be gold, in another silver, and in a third copper, which has the power to restore the lost motility or sensibility. Burq also maintained that the same metal taken internally, whether in the form of a natural mineral water or in a pharmaceutical preparation, produced the same result. In other words, when a piece of metal, a coin, selected according to the special sensibility of the subject, is applied to an hysterical patient having permanent hemianæsthesia, the return of the normal sensibility is effected in from ten to twenty minutes through a space of some extent, above and below the point of application. Numbness, tingling, and other disorders of sensation, dysæsthesia, etc., precede the return of sensibility to the anæsthetic area. The restoration of the sensibility proceeds from the point of application of the metal, and enlarges in all directions until the whole side returns to the normal. At the same time, an elevation of the temperature recognizable by the thermometer, and an increase of motor power as shown by the dynamometer, take place. These changes in the state of the sensory nerves are coincident with dilatation of the capillaries. The special senses undergo the same modifications. Sight, hearing, taste, and smell, are also in the condition of anæsthesia, and as the general sensibility is restored, these special organs return to their normal state.

Such, in brief, were the facts announced by M. Burq. A commission, with M. Charcot at its head, was appointed to investigate the phenomena of metallotherapy. Hitherto the statements in regard to the effects of metals had been received with positive incredulity ; but the commission not only confirmed the accuracy of Burq's observations, but added some new facts. The first discovery made by them was the phenomenon of "transfer." By this term is meant a transference of functional powers. When the sensibility, the temperature, and the muscular power are restored to the side which had been anæsthetic, the other or normal side loses a part of its general and special sensibility. The commission also ascertained that when metals are applied for the relief of hemianæsthesia due to old organic lesions of the nervous centers (such, for example, as cerebral hemiplegia), sensibility is restored also, but in a more durable manner. Thus, in a case of anæsthesia of ten years' duration, produced by a cerebral lesion, this symptom yielded to the application of gold. Other instances of the same character, and equally significant, were reported by the commission. These facts led Charcot to entertain the supposition that the effects produced by the application of the metals are really due to electrical action. It was ascertained, indeed, that electrical currents measurable by the galvanometer are caused by the contact of the metals, and, conversely, that electrical currents of corresponding strength induced the same results as the metals, including the phenomena of transfer. The intensity of the current varies with the metal. In the case of a patient impressionable to gold, a current of two to twelve degrees suffices to restore the sensibility and the muscular force, while in one sensitive to copper, a current of forty to fifty degrees is required to effect the same result (Petit).

As was above stated, when the metal to which the subject is found to be sensitive when applied locally, is given by the stomach, the same result is reached—that is, the anæsthesia is replaced by normal sensibility, the temperature rises to the natural level, and the muscular power is restored. The commission discovered the remarkable fact that if, after the normal is thus resumed, the metal is again applied, the original anæsthesia comes on. To this return anæsthesia Charcot has applied the term *metallic anæsthesia.* A feeble electric current applied under the same conditions produces, also, a return anæsthesia, which is called *postelectric.* When the metallic plates applied to the skin are composed of metals superimposed, the same results as those obtained by a single metal are not produced. Thus, if in a patient sensible to gold a piece of silver is laid on the gold, the effects proper to the latter do not follow. The results due to the application of gold may be rendered durable in some cases by superimposing a piece of silver. If, after the effects produced by the application of a metal to which the patient is sensitive, another metal is placed above the first, the results due to the former may be fixed or rendered permanent.

Notwithstanding the incredulity with which these observations on the action of metals were at first received, they have come to be generally accepted. Prof. Westphal, after a study of metallotherapy at Paris, made some investigations at Berlin, which, on the whole, were confirmatory. Charcot's observations were also sustained by the experiences of Thompson, Horrocks, and Wilks. An important contribution to the subject was made by Dr. Hughes Bennett, when he found that other substances besides metals caused the same results. In this experience we have an illustration of the old and well-known fact that discoveries are being constantly reproduced. When the Perkins excitement was at its acme, Dr. Haygarth, of Bath, announced that wooden cylinders made in imitation of the genuine tractors had the same curative effects. It is clear, however, as M. Vigouroux has well said, that not all substances have the same action. This fact has also been demonstrated by Dr. Hack Tuke, who, having caused the anæsthesia to disappear by the action of a metal, substituted a piece of carbon of similar size and appearance, but the effect did not follow.

Actions and Applications.—Charcot, as has been stated, supposed that the effects produced by the application of metals were due to electrical action. This theory does not suffice to explain all of the effects. By Dr. Tuke, "expectant attention" was invoked to explain the phenomena, but this theory is not tenable. Vigouroux holds that the difference in electrical tension of some point of the organism is the real explanation of the phenomena resulting from the application of metals to the surface.

According to Burq, the order of susceptibility to the impression of metals is as follows, each individual, as a rule, being susceptible to one metal only: iron, copper, gold, silver, tin, platinum (only rarely). These metals are applied in the form of disks, or large coins, and sometimes disks of wood coated with the metals. Some other substances, as mentioned above, have exhibited the same phenomena, but the metals are unquestionably the most important. The metallic disks or coins are placed as a bracelet around the limb to be acted on, or individual disks are held in position by a bandage. The effects follow in a few minutes. The skin, previously pallid, cold, and without sensibility, becomes flushed, warm, and acutely sensitive, and in a short time the special senses are restored to their normal functional activity. As has been described, corresponding losses occur on the other side.

Metallotherapy has been employed chiefly for the restoration of sensibility in cases of the *hemianæsthesia of hysteria*, of *paralysis of sensibility*, in some instances of hemiplegia, and of certain functional *paralyses of motility*. It is not possible to formulate a set of rules for distinguishing the cases which will be benefited by these applications. Sometimes remarkable results are reached in a few applications; then, again, unaccountable failures occur.

Cases of *writer's cramp*, and of *chorea*, among the spasmodic affections, and *neuralgia*, have been suddenly cured by the use of the esthesiogenic metal; but failures are greatly more frequent than the successes. When the metal to which the patient is sensitive has been ascertained, the further treatment may be conducted by the internal use of the same.

Authorities referred to:

[The literature of this subject is now so extensive, that its enumeration would occupy space entirely out of proportion to its utility here. A few of the more important contributions are given.]

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VIGOUROUX, DR. *Le Progrès Médical*, December 7, 1878, p. 944.

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Alumen.—Alum. *Alun*, Fr.; *Alaun*, Ger.

Large, colorless, octahedral crystals, sometimes modified by cubes, and possessing an acid, sweetish, astringent taste. It dissolves in 9 parts of water at 59° Fahr., and in 0·3 part of boiling water, but is insoluble in alcohol. On exposure to the air, absorbs ammonia and acquires a whitish coating.

Alumen Exsiccatum.—Dried alum. Alum deprived of its water of crystallization by heat. A white, granular powder, odorless, but having a sweetish, astringent taste. Slowly but completely soluble in twenty parts of water at 60° Fahr.

Aluminis Sulphas.—Sulphate of aluminum. Has a sour, somewhat sweetish, and astringent taste, and an acid reaction. It is soluble in twice its weight of water.

Antagonists and Incompatibles.—Alkalies and their carbonates and acetate of lead are chemically incompatible.

Synergists.—The mineral and vegetable astringents promote its therapeutical activity.

Physiological Actions.—The sweetish taste of alum first experienced is quickly followed by a decided astringency. It provokes an abundant flow of saliva, and the albumen of the saliva and buccal mucus is coagulated in whitish, membrane-like flakes. Contraction of the capillaries, blanching of the mucous membrane, and subsequent diminution of secretion, take place ; hence the dryness of the throat, thirst, and constipation, which result from its use. In doses of a teaspoonful, or more, alum is an efficient emetic. Under certain morbid states it also proves laxative. Notwithstanding its power to coagulate albumen, it is absorbed into the blood, as was shown by Orfila, and may be found in the liver and in the urine. Circulating in the blood, alum affects the capillaries, diminishing their caliber, lessens secretion, especially of the mucous membranes, and arrests hæmorrhage. In very large doses alum produces decided irritant effects—nausea, vomiting, abdominal pain, diarrhœa, etc.

Dried alum, in consequence of its strong affinity for water, and its power to coagulate albumen, is a mild escharotic.

Therapy.—Alum is one of the remedies which may be used in *gastric catarrh*. It is said to be most effective when there is vomiting of glairy mucus. ℞ Aluminis, ʒ ij ; extract. gentian., ʒ ss. M. Ft. pil. no. xxx. Sig. : *Two pills three times a day*. Alum is a serviceable hæmostatic in *hæmatemesis*. It is, of course, adapted only to cases of passive hæmorrhage, when there is a relaxed condition of the mucous membrane. Other astringents—as, for example, Monsel's salt—are more effective. When *intestinal hæmorrhage* is dependent on mechanical causes (cirrhosis, for example), and the mucous membrane is free from acute inflammation, alum is a serviceable astringent. It was formerly much used in *chronic diarrhœa* and *chronic dysentery*, but more effective agents are now employed in these diseases. The following formulæ are applicable to the above-mentioned diseases, in the absence of more suitable agents : ℞ Aluminis, ʒ ij ; pulv. aromat., ʒ j ; pulv. opii, grs. vj—grs. xij. M. Ft. pulv. no. vj. Sig. : *One powder in honey or sirup three times a day or oftener.* ℞ Aluminis, ʒ j ; extract. opii, grs. x ; catechu, ʒ j. M. Ft. pil. no. xx. Sig.: *Two pills every two, three, or four hours.* ℞ Aluminis, ʒ ij ; pulv. opii, grs. iij —grs. vj ; pulv. kino, ℈ j ; sacch. lactis, ʒ j. M. Ft. pulv. no. vj. Sig.: *One powder every three hours.*

It is a singular fact that the most effective agent for the cure of *colica pictonum* is alum. It relieves the pain and nausea, and overcomes the constipation, more certainly than any other agent. The chemical theory of its action is entirely unequal to the explanation of its remarkable effects; the conversion of any portion of the lead present in the intestinal canal into the insoluble sulphate would not suffice to quiet pain, relieve flatulence, and relax the obstinately constipated bowels. Its action is doubtless dynamical: it overcomes the relaxation and paresis of the muscular layer, on which the phenomena of lead-colic depend. The following are convenient formulæ for the administration of alum in this disease: ℞ Aluminis, ʒ ij; acid. sulphuric. dil., ʒ j; syrup. limonis, ℥ j; aquæ, ℥ iij. M. Sig.: *A tablespoonful every hour or two.* ℞ Aluminis, ʒ ij; vini, ℥ iv; catechu, ʒ j; tragacanthæ, ʒ j; aquæ, ℥ viij. M. Sig.: *A tablespoonful every hour.* Alum-whey, prepared as follows, may be used in lead-colic: To a pint of boiling milk, add ninety grains of alum-powder; separate the curd, and sweeten the whey if desired with an ounce of white sugar. A wineglassful may be taken every hour or two.

Alum not unfrequently affords relief in *gastralgia, enteralgia,* and *catarrh of the intestines.* It is a serviceable laxative in females of lax fiber, in whom constipation depends upon a paretic state of the muscular layer of the bowel. It is true that we possess many other agents more agreeable for administration, and also more effective; but alum is cheap, and always to be obtained.

Alum, dissolved in infusion or solution of the extract of logwood, is a useful injection in *hæmorrhage from the rectum,* or as an application to *bleeding piles,* or as an astringent wash in *prolapsus of the rectum in children.* A crystal of alum, cut into a globular shape, may be passed into the rectum in such cases. The following ointment may be applied to hæmorrhoids when they protrude, bleed, and are painful: ℞ Pulv. aluminis, ʒ ij; pulv. camphoræ, pulv. opii, āā ʒ j; unguent., ℥ j. M. Sig.: *Ointment.*

Notwithstanding the theoretical objections which have been made as to its utility, the use of alum is sanctioned by high authority in *hæmorrhages* from distant organs of the body. Oppolzer recommends the following formula: ℞ Aluminis, amyli, āā ʒ j; sacchari, ʒ ij. M. Ft. pulv. no. vj. Sig.: *One powder every two hours.* Skoda advises the following formula in *hæmoptysis:* ℞ Aluminis, ʒ j; sacch. alb., ʒ ss; pulv. ipecac. comp., ℈ j. M. Ft. pulv. no. vj. Sig.: *One powder every two hours.*

Alum was formerly used in *diabetes mellitus,* but more effective methods of treatment have taken its place. Good results have certainly been produced by the use of alum in *diabetes insipidus. Colliquative sweats* are moderated by the internal use of alum, and by sponging the surface with a solution.

Alum has been used with a certain measure of success in *whooping-cough,* during the spasmodic stage, but the more certain and palatable remedies now in our possession have quite displaced it. As an *emetic in croup*, there is no doubt of the utility of alum. It is used to cause the dislodgment of the false membrane, and to prevent its re-formation. It acts without depressing the bodily functions, is prompt and thorough. A teaspoonful of the powder, mixed with honey or sirup, may be given, and repeated every half-hour until free emesis occurs.

External Uses of Alum.—A solution of alum in nitric ether is said to be an effective application in *toothache* (ʒ ij—ʒ vij). When the *gums are spongy and ill-conditioned*, and manifest a tendency to recede from the teeth, the following local application is very serviceable: ℞ Aluminis, ʒ j; vini, Oj; tinct. cinchonæ, ℥ ss; tinct. myrrhæ, ʒ ij; mel. rosæ, ℥ ij. M. Sig.: *As a mouth-wash.* When there is much relaxation of the faucial mucous membrane, alum and sugar, in equal proportions, may be applied by an insufflation-tube. Powdered alum, dusted over the affected surface, is a useful application in *chronic pharyngitis, chronic tonsillitis, chronic nasal catarrh. Ulcers of the mouth*, whether syphilitic, or due to nursing, or arising from gastric disorder, are improved in character by application of a crystal of alum. A useful gargle in various affections of the mouth and throat is the following: ℞ Infus. lini, ℥ xv; tinct. kino, ℥ j; aluminis, ʒ ij. M. Sig.: *As a gargle.*

In *catarrhal ophthalmia*, after the acute symptoms have subsided, an alum-lotion is useful: ℞ Aluminis, ℈ j; aquæ rosæ, ℥ iv. M. Sig.: *Lotion.* Alum-curd is a domestic application which is often serviceable: ʒ ss of alum to the white of an egg.

The following is a useful injection in *chronic gonorrhœa:* ℞ Aluminis, ʒ j; zinci sulphatis, ʒ ss; sodii biborat., grs. iv; aquæ rosæ, ℥ viij. M. Sig.: *An injection.* This prescription is equally applicable to *leucorrhœa.*

Alum is a useful *hæmostatic*, but there are others more powerful. Alum is a constituent of the once famous Pagliari's mixture (Mentel's): ℞ Benzoini, gr. c; alcohol. fort., ℥ ss. Dissolve and add water, ℥ x; alum, ℥ j. The mixture is to be boiled until clear, and, when cool, filtered. This is also a good preservative solution for anatomical preparations, and is an effective application in *leucorrhœa, pruritus of the vulva*, etc.

Alum ℥ ss, the whites of four eggs, and tincture of camphor ℥ ij, is an excellent application to *bed-sores.* Burned alum is a mild escharotic, which is sometimes used to destroy *exuberant granulations.*

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Waldenburg und Simon. *Handbuch der Arzneiverordnungs-Lehre*, p. 154.

Alumnol.—Under this name is known a naphthol-sulphonic-acid salt of aluminum. It is supposed to contain 5 per cent of aluminum and 15 per cent of sulphur, and is a white powder soluble in water, slightly soluble in alcohol, and insoluble in ether. It may be applied as a powder undiluted, or mixed with talc or starch, or in solution in water. So active is it as a germicide that a one-per-cent solution will inhibit pathogenic bacteria. It is a decided astringent, and this action is not limited to the surface on which it is applied, but penetrates to the tissues beneath. It also causes contraction of the vessels when applied to the frog's mesentery even in a very dilute solution.

Therapeutically, alumnol is applied to the treatment of wounds, injuries, abscesses, ulcers, and affections of the skin. For chancroids, erosions, and abscesses, alumnol powder undiluted may be applied. In acute troubles of the skin and mucous membrane it should be diluted with starch to 10 or 20 per cent. *Balanitis*, freely discharging *eczema*, and *burns* of the first degree are conditions in which the diluted powders are made use of. The solution in water of 1 to 5 per cent is of suitable strength in *gonorrhœa*. An ointment prepared with lanolin or lard is also employed in skin diseases. In most of the diseases in which it has been used alumnol has had satisfactory results.

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Boral, Cutol, and Cutolum Solubile are names given to preparations of aluminum recently prepared by Leuchter, an apothecary of Berlin, and subsequently submitted to clinical investigation by Dr. Koppel, whose paper appeared in the *Therapeutische Monatshefte* for November, 1895.

Boral is obtained by the reaction of boric and tartaric acids on aluminum; cutol, of boric and tannic acids. Cutolum solubile is cutol rendered soluble by the action of tartaric acid. Boral and cutol are powders employed in that form, or mixed with chalk and talc or made into ointment.

These preparations are indicated in forms of cutaneous disease, as eczema, catarrh of the mucous membrane, hyperidrosis, etc. According to Koppel, the following recipe is an excellent application to hæmorrhoids: ℞ Cutol, 5·0 = 75 gr.; olei olivarum, 2·0 = ʒ ss.; lanolini, 40·0 = ℥ j and ʒ ij; adde liq. plumbi subacetat., 1·0 = 15 gr. M. Ft. ung. Or the following: ℞ Cutol, 3·0 = 45 gr.; olei olivarum, 2·0 = ʒ ss.; acid. carbol. liq., gtts. vj; lanolini ad., 30·0 = ℥ iv. M. Ft. ung.

It may be said of these combinations that they are indicated and will probably be found useful in the same kind of cases as alumnol.

Acidum Tannicum.—Tannic acid. *Tanin*, Fr.; *Tanninum*, Ger.

Tannic acid has a yellowish-white color and strongly astringent taste. It is soluble in about 1 part of water, in 0·6 part of alcohol, and in 1 part of glycerin with a moderate heat. Its solution reddens litmus, and produces, with solution of gelatin, a white, flocculent precipitate; with the salts of the sesquioxide of iron a bluish-black precipitate; and with solutions of the alkaloids white precipitates, very soluble in acetic acid. Dose, gr. j—℈j.

Collodium Stypticum.—Styptic collodion. (Tannic acid, 20 grm.; alcohol, 5 c. c.; stronger ether, 25 c. c.; collodion, q. s. to make 100 c. c.)

Trochisci Acidi Tannici.—Troches of tannic acid. (Each troche contains one grain of tannic acid.)

Unguentum Acidi Tannici.—Ointment of tannic acid. (Tannin, 20 grm.; benzoinated lard, 80 grm.)

Glyceritum Acidi Tannici.—Glycerite of tannic acid. (Tannic acid, 20 grm.; glycerin, 80 grm.)

Acidum Gallicum.—Gallic acid. *Acide gallique*, Fr.; *Galläpfelsaure*, Ger.

Gallic acid is in small, silky, nearly colorless crystals, having a slightly acid and astringent taste. It is soluble in one hundred parts of cold and in three of boiling water. The solution reddens litmus, and does not produce a precipitate with a solution of gelatin, or of sulphate of protoxide of iron. With solutions of salts of sesquioxide of iron it produces a bluish-black precipitate, the color of which disappears when the liquid is heated. It is decomposed by a strong heat, and entirely dissipated when thrown on red-hot iron. Dose, gr. j—gr. x.

Unguentum Acidi Gallici.—Ointment of gallic acid. (Gallic acid, 10 grm.; benzoinated lard, 90 grm.)

The following remedies contain a tannic acid, and have physiological and therapeutical actions due to the presence of this substance:

Galla.—Nutgall. *Noix de galle*, Fr.; *Galläpfel*, Ger.

Tinctura Gallæ.—Tincture of galls. Dose, ʒ ss—ʒ ij.

Unguentum Gallæ.—Ointment of galls. (Galls in fine powder, 20 grm.; benzoinated lard, 80 grm.)

Composition.—Tannic acid (gallo-tannic), 60 to 70 per cent; gallic acid, 3 per cent; sugar, resin, etc.

Catechu.—Catechu. An extract prepared principally from the wood of *Acacia catechu*. *Cachou*, Fr.; *Katechusafe*, Ger.

Tinctura Catechu Composita.—Tincture of catechu. (Catechu, 100 grm.; cinnamom, 50 grm.; diluted alcohol, a sufficient quantity to make 1,000 c. c.) Dose, ♏ x—ʒ j.

Infusum Catechu Compositum.—Compound infusion of catechu. (Not official.) (Catechu, ℥ ss; cinnamon, ʒ j; boiling water, Oj.) Dose, ʒ j—℥ ss.

Trochisci Catechu.—Troches of catechu. Each troche contains one grain of catechu.

Composition.—Catechin, or catechuic acid.

Kino.—Kino. The inspissated juice of *Pterocarpus marsupium*, and of other plants (Nat. Ord. *Leguminoseæ*). *Kino de l'Inde*, Fr.; *Kino Gummi*, Ger.

Tinctura Kino.—Tincture of kino (100 grm. to 1,000 c. c.). Dose, ♏ x—ʒ ij.

Composition.—Kino-tannic acid.

Krameria.—Rhatany. The root of *Krameria trianda* and of *K. ixina* Linné (Nat. Ord. *Polygalæ*). *Ratanhia*, Fr.; *Ratanhiawurzel*, Ger.

Extractum Krameriæ.—Extract of rhatany. Dose, gr. v—gr. x.

Tinctura Krameriæ.—Tincture of rhatany (200 grm. to 1,000 c. c.). Dose, ♏ v—ʒ j.

Extractum Krameriæ Fluidum.—Fluid extract of rhatany. Dose, ♏ v—ʒ ss.

Composition. — Ratanhia-tannic acid; odorous principle; wax, gum, etc.

Hæmatoxylon.—Logwood. The heart-wood of *Hæmatoxylon campechianam* Linné (Nat. Ord. *Leguminoseæ*). *Bois de Campêche*, Fr.; *Campecheholz*, Ger.

Decoctum Hæmatoxyli.—Decoction of logwood. (Not official.) (Logwood, ℥ j; water, Oij, boiled down to Oj.) Dose, ℥ ss—℥ j.

Extractum Hæmatoxyli.—Extract of logwood. Dose, gr. v—℈ j.

Composition.—Hæmatoxylin, tannic acid, etc.

Geranium.—Cranesbill. The rhizona of *Geranium maculatum* Linné (Nat. Ord. *Geraniaceæ*).

Extractum Geranii Fluidum.—Fluid extract of geranium. Dose, ♏ v—ʒ j.

Composition.—Tannic and gallic acids, resin, gum, starch, chlorophyll, etc.

Quercus Alba. — White-oak bark. The bark of *Quercus alba* Linné (Nat. Ord. *Cupuliferæ*).

Quercus Tinctoria.—Black-oak bark. (Not official.) *Écorce de chêne*, Fr.; *Eichenrinde*, Ger.

Decoctum Quercus Albæ.—Decoction of white oak. (Not official.) (℥ j—Oj.) Dose, ℥ ss—℥ j.

Composition.—Quercitrin or quercitric acid, tannic acid, etc.

Rosa Gallica.—Red rose. The petals of *Rosa gallica* Linné (Nat. Ord. *Rosaceæ*). *Roses rouges*, Fr.; *Essigrosen*, Ger.

Confectio Rosæ.—Confection of rose.

Extractum Rosæ Fluidum.—Fluid extract of rose. Dose, ♏ v—ʒ ij.

Mel Rosæ.—Honey of rose.

Composition.—Tannic and gallic acids, quercitrin, coloring matter, volatile oil, etc.

Rubus.—Blackberry-root. Bark of the root of *Rubus Canadensis* and *Rubus villosus.*

Extractum Rubi Fluidum.—Fluid extract of rubus. Dose, ♏ x—ʒ ij.

Composition.—Tannic acid, etc.

Myrica Cerifera.—Bayberry, wax-myrtle. (Not official.) Bark of the stem and root.

Decoction is made by boiling an ounce in a pint of water—dose, ℥ ss—℥ j. An alcoholic extract (*myricine* of the eclectics)—dose, grs. v; and a fluid extract—dose, ʒ ss—ʒ ij—are to be obtained in the shops.

Composition.—Tannic and gallic acids, myricinic acid, resin, red coloring matter, etc.

The most important property is the astringency due to the large quantity of tannic and gallic acids. In large doses it is emetic.

Statice Limonium.—Marsh rosemary. (Not official.) The root. A decoction (℥ j—Oj) may be used—dose, ℥ ss—℥ j. A fluid extract is prepared—dose, ♏ xx—ʒ j.

Composition.—Tannic acid (twelve per cent), gum, extract, etc.

Alnus Serrulata.—Common alder. (Not official.) The bark in decoction (℥ j—Oj)—dose, ℥ ss—℥ j. Fluid extract—dose, ♏ x—ʒ j. Alcoholic extract (*alnuin* of the eclectics)—dose, gr. j—grs. v.

Composition.—Tannic acid, oil, resin, etc.

Heuchera.—Alum-root. Root of *Heuchera Americana.* (Not official.) Decoction—dose, ℥ ss—℥ j; fluid extract—dose, ♏ x—ʒ j.

Composition.—Tannic acid, etc.

Hamamelis.—The leaves of *Hamamelis virginiana* (Nat. Ord. *Hamamelaceæ*). Witch-hazel.

Extractum Hamamelidis Fluidum.—Fluid extract of *hamamelis.* Dose, ♏ x—ʒ ij.

Composition.—Tannic acid, volatile oil, etc.

The extraordinary claims put forth of late years as to the powers of hamamelis are hardly tenable. It has no physiological effect, except that which belongs to an agent rich in tannin.

Nymphæa Odorata.—Sweet-scented water-lily. Root. Decoction (℥ j—Oj)—dose, ℥ ss—℥ j. Fluid extract—dose, ʒ ss—ʒ j. (Not official.)

COMPOSITION.—Tannic acid, gallic acid, etc.

Castanea.—Leaves of *Castanea vesca* Linné (Nat. Ord. *Cupuliferæ*), collected in September or October, while still green. (U. S. P.)

COMPOSITION.—Tannic acid, etc.

ANTAGONISTS AND INCOMPATIBLES.—The mineral acids, the salts of antimony, lead, and silver, and the persalts of iron, and alkalies, are chemically incompatible. The vegetable alkaloids and gelatin form insoluble precipitates.

SYNERGISTS.—Tonics and bitters, as a rule, favor the action of tannic and gallic acids, and of the substances containing them. The agents comprehended in this group—or remedies whose chief result is to increase waste—are synergistic.

PHYSIOLOGICAL ACTIONS.—Tannin has a bitter astringent taste, and constringes the mucous membrane. In the stomach it enters into combination with albumen, and with the pepsin of the gastric juice, which it precipitates from its solution. Tannin, therefore, impairs digestive power by rendering the pepsin inoperative. It diminishes secretion of the mucous membrane by virtue of its power to contract the caliber of the vessels, and it restrains peristalsis by its action on the muscular layer; hence the constipating effects which follow its use. If long continued in considerable quantity, tannin disorders digestion, sets up irritation of the mucous membrane, and gives rise to a febrile state and to wasting of the tissues.

Having such affinity for and coagulating action on albumen, it is obvious that tannin must diffuse into the blood with difficulty. A part undergoes conversion into gallic and pyrogallic acids in the stomach, and in this form is absorbed. Injected into the veins, tannic acid coagulates albumen, and the results which follow are due to multiple embolisms. Elimination of tannin takes place by the intestinal canal and by the kidneys, in the form of gallic and pyrogallic acids.

THERAPY.—*Catarrh of the stomach, a relaxed state of the mucous membrane, acidity, and flatulence*, are conditions in which tannic acid is useful. It may be given in pill-form with sufficient glycerin to make a mass of proper consistence—one drop to four grains. *Hæmatemesis* dependent on ulcer of the stomach, or obstructive disease of the liver, and not inflammatory in origin, is an indication for tannin. It should be given in solution and in a large dose—grs. x—℈j. Tannic acid is an efficacious remedy in *diarrhœa*, after acute symptoms have subsided, in *chronic diarrhœa, colliquative diarrhœa*, the *diarrhœa* *of phthisis*, etc. Notwithstanding the chemical incompatibility, combination with opium or morphine increases the efficacy of the tannin. As tannic acid, in large part, at least, escapes conversion into gallic, and passes unchanged into the intestine, its action is doubtless chiefly local. Oppolzer advises the following formula in *profuse diarrhœa:* ℞ Acidi tannici, ʒ ij; pulv. opii, grs. vj; sacchari, q. s. M. Ft. pulv. no. vj. Sig.: *One every two hours.* In *cholera diarrhœa*, A. von Graefe prescribed a solution of tannic acid in cinnamon-water and mucilage every half-hour. For the *diarrhœa* and *intestinal hæmorrhage of typhoid fever*, tannin is one of the most serviceable remedies. According to Stillé, whose faith appears rather extravagant, there is no more effective remedy for *chronic diarrhœa* and *chronic dysentery* than tannic acid conjoined with a milk-diet.

Various members of this group are used in the above-mentioned diseases. Kino has been a favorite remedy in *pyrosis*, and is also given in *diarrhœal diseases.* Catechu, in the form of the tincture chiefly, is frequently added to prescriptions for diarrhœa, notably to chalk-mixture in the diarrhœa of children. Kino is a favorite remedy for the *diarrhœa of phthisis*, but it is not more efficacious, and is more disagreeable in administration, than tannic acid. Several of the indigenous remedies mentioned above possess undoubted value in the treatment of diarrhœal diseases. A decoction of rubus or geranium, obtained by boiling the root in milk (℥ j—Oj), is an excellent remedy in *cholera infantum* and the *summer diarrhœa of children.* When a nursing child passes rather frequent, greenish, and watery stools, and suffers with pain and colic at each motion, great relief will be afforded by the use of syrupus rubi, or better by the unofficial compound sirup of rubus. In the *chronic diarrhœa* of adults, and in *acute diarrhœa after the subsidence of inflammatory symptoms*, the fluid extracts of hamamelis, of heuchera, and of statice, may be used with advantage. In *hæmatemesis* and *intestinal hæmorrhage* the hamamelis is very effective, owing, doubtless, to the very large percentage of tannin which it contains.

The comparative merits of tannic and gallic acids may be formularized as follows: for local effects tannic acid, for systemic effects gallic acid is to be preferred. It is true that tannic acid affects remote parts, but in order to diffuse into the blood it must first be converted into gallic, and hence the systemic actions are really due to the latter. It follows that gallic acid should be prescribed when the astringent effects on the tissues elsewhere than the intestinal canal are to be produced. Gallic acid is an effective remedy for *pulmonary* and *renal hæmorrhage.* For the former we possess other agents more efficient, but for the latter it is more uniformly successful than any other remedy. The success of rhatany, which was formerly much used in *hæmaturia*, was doubtless due to its tannic and gallic acids. In the *hæmorrhagic diathesis*, gallic acid is one of the remedies which may be used with advantage. Although it can not be combined with chalybeates, it may be given alternately with them. Whenever hæmorrhage occurs in relaxed and debilitated constitutions—is passive in character—gallic acid may be combined with ergotine and digitalis: ℞ Acid. gallici, ʒ i; ergotine (aq. ex.), digitalis, āā ℈j. M. Ft. pil. no. xx. Sig.: *One every four hours.*

As gallic acid has the power to restrain secretion of mucous surfaces, it may be prescribed, experience has shown with good effect, in *chronic bronchial catarrh.* When bronchiectasis exists, the good effects of the remedy are by no means conspicuous, but it is very serviceable when the bronchial catarrh is the result of the irritation extending from disease of the parenchyma of the lungs, or is produced by mitral or tricuspid regurgitation, or is the sequel of acute catarrh. In *pyelitis* and *pyelo-nephritis*, gallic acid and the remedies containing it diminish the purulent discharge, and retard changes in the mucous membrane. It is also a serviceable remedy in *catarrh of the bladder.* In these states, to insure as far as possible its rapid and complete diffusion into the blood, it should be given frequently and well diluted. As it is soluble in eight parts of rectified spirit, and as this solution mixes in all proportions with water without precipitation, a spirituous solution should be prescribed: ℞ Acidi gallici, ʒ j; spirit. vini rectif., ℥ j. M. Sig.: *A teaspoonful in sufficient water every four hours.*

Gallic acid has the power to restrain the waste of albumen in cases of *albuminuria.* It is adapted to the acute forms—*desquamative nephritis*, the *albuminuria following scarlatina*, etc., and does not seem, according to the author's observation, to check in the least the loss of albumen in the chronic forms of albuminuria. Dr. Aitken recommends the following formula: ℞ Acidi gallici, ʒ j—ʒ ij; acid. sulphuric. dil., ʒ ss; tinct. lupuli, ʒ j; infus. lupuli, ℥ vj. M. Sig.: *A tablespoonful three times a day.*

The following mixture is very effective in *menorrhagia, hæmaturia, purpura hæmorrhagica*, and the *hæmorrhagic diathesis:* ℞ Acidi gallici, ʒ ss; acid. sulphur. dil., ʒ j; tinct. opii deod., ʒ j; inf. rosæ comp., ℥ iv. M. Sig.: *A tablespoonful every four hours or oftener.*

Hillier advises the following prescription for *chronic diarrhœa* in a child of two years: ℞ Acidi gallici, gr. xij; tinct. cinnamomi comp., ʒ jss; tincturæ opii, ♏ viij; aquæ carui ad ℥ ij. M. Sig.: *Two teaspoonfuls a dose.*

For the *sweating of phthisis* the following formula is useful: ℞ Acid. gallici, ʒ ss; ext. belladonnæ, gr. ij. M. Ft. pil. no. x. Sig.: *Two pills at bed-hour.*

In addition to the foregoing internal applications of the vegetable astringents, it may be mentioned that a decoction of chestnut-leaves (castanea) has been used with much success in *whooping-cough.* As both tannic and gallic acids have been employed with more or less service in this disorder, it is probable that the good effects of castanea are really due to the presence in it of these acids. The decoction of castanea may be drunk *ad libitum*, or the fluid extract may be administered in drachm-doses.

External Uses of Tannic Acid and Substances containing it. —Dr. B. W. Richardson has proposed a tannin solution, to which he has applied the term *styptic colloid*. It consists of a saturated solution of tannin in alcohol (one part to eight) mixed with collodion. This is an elegant application to restrain *oozing of blood from a large surface, to unite incised wounds, to protect lacerated wounds, to remove fetor from decomposing animal matter, to change the character of foul ulcers*, etc. The following formula was proposed by Monsel as a *hæmostatic:* ℞ Acidi tannici, ℈ j; aluminis, ℈ ij; aquæ rosæ, ℥ iij. M. Sig.: *For external use as a hæmostatic.* The glycerite of tannin is a neat formula for external application.

Tannic acid is much employed as an application to the mouth and throat in various diseases of these parts. In *mercurial salivation* an excellent application is a solution of tannin, with honey of roses: ℞ Acidi tannici, ʒ j; mel rosæ, ℥ ij; aquæ, ℥ vj. M. Sig.: *As a gargle. Elongated uvula, relaxed palate,* and *follicular pharyngitis*, are effectively treated by insufflation of tannin, i. e., some finely-powdered tannin blown over the affected surface with a hand-ball insufflator. *Epistaxis* may often be promptly arrested by passing through the nares a strong solution of tannin (ʒ ij—℥ iv) by means of a post-nasal syringe or nasal douche, or powdered tannin may be blown on the bleeding surface by an insufflator. The following is an excellent *gargle* for the more chronic throat-affections: ℞ Acidi tannici, ʒ ij; spts. vini rect., ʒ j; mist. camphor. ad ℥ x. M. Sig.: *An astringent gargle.* In chronic affections of the larynx mucous membrane, and of the vocal cords, no inhalation is more frequently serviceable than a solution of tannin (grs. x—℈ j—℥ iv) applied by means of the hand-ball or steam atomizer. This treatment is useful in *chronic catarrh of the fauces, of the larynx, trachea, and bronchi*, in *ulcerations of the pharynx, larynx, and trachea*, in *bronchiectasis*, in *pulmonary hæmorrhage, gangrene of the lung, œdema of the glottis, croup*, and *diphtheria.*

The following is Druitt's prescription for *toothache:* ℞ Acidi tannici, ℈ j; mastich, grs. x; etheris, ℥ ss. M. Sig.: To be applied on cotton to a carious tooth.

Tannin solutions of various strengths (gr. j—grs. x—℥ j) are used in *inflammation of the conjunctiva.* Hairion advises a strong solution (ʒ j—ʒ iij) in *acute and chronic conjunctivitis, granulations, corneitis, chemosis*, and *pannus.* Very remarkable results have been obtained by Dr. Hamilton, of Liverpool, in certain diseases of the eye by the application of powdered tannin to the conjunctiva. This method consists in dusting over the everted lid finely-powdered tannic acid, using for this purpose a small rubber-bag insufflator. He employs this method with signal success in "*granular ophthalmia, pannus, phlyctenular* or *pustular ophthalmia, chronic granulations, herpes corneæ, fascicular corneitis, and some ulcers of the cornea.*" This application produces very little pain at the moment, and is not followed by any inflammatory reaction.

Tannic acid has limited uses in diseases of the skin. It is an excellent application, especially in the form of the glycerite, in *eczema, impetigo*, and *intertrigo*. The powder dusted on the affected surface is serviceable in cases of *ulceration of the skin*, and promotes the healing process in cases of old ulcers. One of the best applications to *irritable and fissured nipples* is *glycerite of tannin.*

Chronic otorrhœa and the *vulvitis of children* are successfully treated by application of the glycerite of tannin. The same remedy is one of the best injections in *gonorrhœa*. Solutions of tannic acid of various degrees are used in gonorrhœa. Ricord recommends, in obstinate cases, after the subsidence of acute symptoms, ʒ ss of tannic acid in ℥ viij of claret wine. This constitutes a serviceable injection in *leucorrhœa*. Sigmund advises the following in *gonorrhœa:* ℞ Acidi tannici, grs. ij—grs. x; tinct. iodinii, ♏ v; aquæ, ℥ j. M. Sig.: *As an injection.* An infusion or decoction of galls, of oak-bark, of witch-hazel (hamamelis), of geranium, of alum-root, or other remedies of the list at the head of this article, may be advantageously used in *cervicitis, vaginitis, purulent discharges from the vagina.* In these affections the glycerite of tannin, and, much better, the powdered tannin, may be freely applied to the vaginal canal. The author knows of no more effective application in these maladies than tannin and iodoform, or iodo-tannin, applied in the dry way, well packed around the *cervix uteri.*

A serviceable ointment for *hæmorrhoids* is the following prescription of Oesterlen: ℞ Pulv. gallæ, ℈j; pulv. opii, grs. x; ung. plumbi subacetat., ℈ij; ung. simplicis, ʒ j. M. Sig.: *Ointment for hæmorrhoids.* For *prolapsus ani* in children the glycerite of tannin, powdered tannin, or a decoction of the vegetable astringents considered in this article, may be used, the mucous membrane being first carefully cleansed and then brushed over with the medicament. *Ulcers of the rectum and anus, fissures of the anus,* are very effectively treated by the direct application of the powder of tannin, tannin and iodoform, or iodo-tannin. The ulcer must be exposed, if necessary, by the use of the speculum, and then the powder be thoroughly applied to the affected surface. Trousseau strongly recommends a mixture of the decoction and the tincture of rhatany as an injection for the cure of fissure of the anus, but the applications above advised are neater and more effective.

Pyrogallol.—*Pyrogallic acid.* A triatomic phenol.

Properties.—Gallic acid, subjected to a high temperature, loses its water of crystallization and becomes *pyrogallic acid.* This is a white, shining powder, crystalline in structure, without odor, and having a persistent bitter taste. It is soluble in two and a half parts of water, and to some extent in alcohol and ether. For exhibition by the stomach, the pill-form is best, the excipient being some unoxidizable substance, and the coating complete. The dose for internal administration will range from one sixth of a grain to two grains. For topical application, solutions are preferred, and they vary in strength from one to ten per cent. Solutions can not be kept long, because of chemical changes; exposed to light, the color becomes brownish, and the power declines with the loss of oxygen.

Pyrogallic acid is an active poison, and this property is exhibited as well when administered by the stomach as when applied to an abraded surface on the skin. Caution in its use becomes necessary, therefore, for several instances of fatal poisoning, and numerous cases in which the toxic action was stopped by treatment, have been reported.

Pyrogallic acid is an irritant poison, and all the characteristic actions of that group of remedies follow its administration in sufficient quantity—nausea, vomiting, purging, accompanied by intense gastro-enteric inflammation (Besnier). The changes wrought in the blood are significant in a high degree. It impairs or destroys the respiratory function of the blood by the damage it inflicts on the red corpuscles, which are disorganized, the hæmoglobin separated. Changes in the intima of the blood-vessels, fatty and fibroid degeneration of organs, especially of the liver and kidneys, are constant results of its toxic activity (Neisser); and of these lesions, we find the clearest evidence in the changes which take place in the urine, which becomes brown, almost black, and by the presence in it of hæmoglobin, or the products of its decomposition. Decline in temperature, profound anæmia, hæmorrhages, especially hæmaturia, are also most clearly significant of the toxic action. It need hardly be observed that such dire results are toxic, and the quantity of the agent necessary to produce them is much beyond ordinary medicinal doses.

The elimination of pyrogallic acid takes place by the ordinary channels, but especially by the kidneys and liver. It is probable that the structural changes in the eliminating organs are due to the immediate contact of the acid as it passes out of the system.

Therapy.—The use to which pyrogallic acid was first applied, was suggested by its therapeutical relationship to chrysarobin. As is now well known, *chrysarobin*, under the designation "Goa powder," has proved to be an efficient remedy for psoriasis and parasitic affections of the skin. If pyrogallic acid is not so certain, which may well be doubted, it has great advantages. Both color and irritate or inflame the skin, but pyrogallic acid is far less injurious in its local action (Jarisch).

Having very powerful germicide action, pyrogallic acid is an efficient remedy in *pityriasis versicolor*, *herpes tonsurans*, *favus*, etc., and it has also exhibited some curative action in more serious affections, as *lupus* and *epithelioma.*

The strength of the solutions used has ranged from one hundredth to one tenth per cent. The ointment made in these proportions with vaseline or lard—more frequently vaseline—is held to be less effective than solutions of the same, which are also more readily applied (Arragon, Kaposi).

If the solutions or unguents are too strong, or frictions too forcibly made, violent inflammation may be set up, and permanent injury done to the skin. More or less brownish discoloration of the skin is an effect of the application, but it is not permanent. The aqueous or alcoholic solution of pyrogallic acid can be applied to the affected surface by means of absorbent cotton, the strength of the solution and the duration of the application being regulated by the effect it has on the diseased surface. As, however, toxic effects follow if the application is made over too extensive surface, a part of the diseased area only should be treated at one time.

M. Vidal has made the important announcement that the ointment of pyrogallic acid is an excellent application to chancroid, especially if it tends to slough. A few applications change the character of the sore, and soon effect cicatrization.

In the treatment of *ulcers, sloughing phagedena, epithelioma,* and similar conditions, pyrogallic acid may be mixed with a powder—kaolin or starch, for example—and then well dusted over the diseased part.

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Tannigen.—As the name implies, this is a derivative of tannin, and has for its formula ($C_{14}H_8[CH_3CO]_2O_9$). It was originally produced by Meyer, of Marburg, and the first investigation of its properties was made by Fr. Müller, of Bonn ; afterward was employed in the medical clinic by Kunkler, and by Drews, of Hamburg.

Tannigen is an odorless, tasteless, grayish-yellow powder, soluble to a slight extent in water, but dissolves freely in alcohol and in solutions of the alkaline salts. The dose for internal administration ranges from 1 to 10 or even 15 grains. It is preferably given in powder. Locally, the powder can be applied undiluted. It is not poisonous. Apparently it does not alter in any way the condition of the stomach, except as an astringent. In the presence of alkaline salts it preserves its astringent property, and hence its powers are not impaired by the intestinal juices. It undergoes saponification in its passage through the intestinal canal, but some part of that administered escapes unchanged in the fæces. Of that absorbed by oxidation, it is converted into gallic acid and in this form appears in the urine.

Tannigen has thus far been chiefly used as a remedy for the *diarrhœa* of children. It has been found especially useful in the *ileocolitis* of early life. In chronic cases it has seemed far less efficient. It possesses great advantage as a remedy for children, in that the powder is odorless and tasteless.

By Müller, tannigen has been used successfully in the treatment of *gastric catarrh*, *pyrosis*, and other affections in which tannin has been heretofore used. Local application of the powder has been made in catarrhal affections of the nasal and faucial mucous membrane. It will probably prove a useful substitute for tannin.

Ichthyol.—The source of ichthyol is a bituminous mineral rich in the remains of fossilized fish and other marine animals. From this mineral it is derived by distillation, and is subsequently treated with sulphuric acid, yielding a sulphonate. Neutralized by ammonium and sodium, corresponding ammonium and sodium ichthyol salts are obtained.

Ichthyol is rich in sulphur—containing about 10 per cent—and this is chemically combined with the other ingredients, and partly with oxygen and partly with carbon. It is an oily substance, with a bituminous odor and taste, a reddish-brown color, and is freely soluble in water and in a mixture of equal parts of alcohol and ether, and also mixes well with lonolin, vaselin, and fats and oils generally. It is the ammonium salt of ichthyol that answers to the foregoing description.

Thiol is for the most part preferred to ichthyol. They are isomeric, but thiol is purer in form, less irritating, and has no toxic properties. The facts stated of ichthyol are equally true of thiol, with the important exception that thiol is much more pleasant for administration, and may be given more freely without risk.

Actions and Uses.—Notwithstanding its odor and taste, ichthyol is well borne by the stomach, and promotes appetite and digestion. It increases assimilation and hinders retrograde metamorphosis, whereby the nutrition is improved and the body-weight brought up to the normal level. According to Dr. Cranstoun Charles, massive doses of ichthyol caused in animals only diarrhœa. The same results were arrived at by Prof. Baumann and Dr. Schotten. Dr. Helmers, in Zuntz's laboratory, found that in experiments on himself it was without any injurious effect, but promoted the metabolism in which sulphur is concerned, and the amount of this substance which had accumulated required seven days in which to become eliminated. It has a decided antiseptic action, and is fatal to pathogenic organisms. It increases the volume and force of the circulation after stimulating the primary assimilation.

As a compound rich in sulphur, it is adapted to the treatment of those morbid states in which this substance has proved efficacious. According to Unna, of Hamburg, it is serviceable in cases of acne, furuncle, lepra, sycosis, and other cutaneous diseases. Similarly, it is effective in erysipelas, erythema, eczema, and analogous affections. Unna finds that it diminishes heat, reduces swelling, and relieves pain. In the treatment of skin diseases he employs the remedy internally as well as topically. The dose for internal administration in such cases ranges from 5 to 10 grains two or three times a day. It is usually dissolved in water for this purpose. Of equal parts of ichthyol and water, 5 to 20 drops three times a day are usually given. For application to eruptions, the proportion of ichthyol ranges from 1 to 10 parts. It is mixed with water, glycerin, vaselin, and lanolin, in varying proportions, according to the effects desired, or it is combined with zinc-ointment, soft soap, and other unguents. The following are among the more useful combinations: ℞ Ichthyol, lanolin, vaselin, equal parts. M. ℞ Ichthyol, 4 parts; sulphur, precipitated, 4 parts; wheat starch, 20 parts; zinc oxide, 20 parts; vaselin, 40 parts. M. A paste for the face. In the treatment of gastro-intestinal catarrh it may be given as follows: ℞ Ichthyol, 30 to 60 parts; oil of peppermint, 1 part; absolute alcohol, 10 parts; distilled water, 1,000 parts.

Good results are claimed for ichthyol in the treatment of phthisis, chronic rheumatism, chronic alcoholism, and chronic wasting diseases. Cohn maintains its superiority over guaiacol as a remedy for phthisis. The explanation of its utility in wasting diseases is afforded by the remarkable influence over the retrograde metamorphosis of certain constituents of the body, and in its effects in retarding the disintegration of the albumins and in favoring their accumulation and formation. As Zuelzer and others have shown, it has a remarkable power to check waste, the urinary solids and the nitrogenous excreta being greatly diminished. Hence it is under its administration the body weight increases, the income is promoted and the outgo lessened, and these important results are accomplished without in any way impairing digestion or irritating the gastro-intestinal mucous membrane. In rheumatic affections, applications to the affected joints are combined with the internal administration of the same. Remarkable results are claimed for this agent in the treatment of gonorrhœa. A warm solution of one half to one per cent of ichthyol has been used quite successfully; with this the canal may be thoroughly irrigated.

Colchicum.—Meadow saffron. *Colchique*, Fr.; *Zeitlose*, Ger.

Colchici Radix.—Colchicum-root. The corm of *Colchicum autumnale* Linné (Nat. Ord. *Liliaceæ*).

Colchici Semen.—Colchicum-seed. The seed of *Colchicum autumnale.*

PREPARATIONS.—1. Of the root.

Extractum Colchici Radicis Fluidum.—Fluid extract of colchicum-root. Dose, ♏ ij—♏ v.

Vinum Colchici Radicis.—Wine of colchicum-root. (Four hundred grm. of colchicum-root; alcohol, 150 c. c.; white wine to make 1,000 c. c. Dose, ♏ v—♏ xxx.)

Extractum Colchici Radicis.—Acetous extract of colchicum-root. Dose, gr. ss—gr. ij.

2. Of the seed.

Extractum Colchici Seminis Fluidum.—Fluid extract of colchicum-seed. Dose, ♏ ij—♏ x.

Tinctura Colchici Seminis.—Tincture of colchicum-seeds. (Colchicum-seeds, 150 grm., to 1,000 c. c. of diluted alcohol.) Dose, ♏ x —ʒ j.

Vinum Colchici Seminis.—Wine of colchicum-seed. (One hundred and fifty grm. of the seed; alcohol, 150 c. c.; a sufficient quantity of white wine to make 1,000 c. c.) Dose, ♏ x—ʒ j.

COMPOSITION.—Tannic and gallic acids, starch, sugar, gum, a peculiar alkaloid, *colchicina* or *colchicine.* Colchicine is easily converted (by acids, in long-kept alcoholic preparations) into an isomeric, cystallizable body, *colchiceïn.* The amount of the alkaloid contained in the root and the seed is said to be not greater than the half of one per cent. Colchicine is not crystallizable, but combines with acids to form crystallizable salts. The conversion, in any of the pharmaceutical preparations, of colchicine into colchiceïn, does not appear to impair the therapeutical activity. That colchicine is the active principle, is proved by the fact that the physiological effects of this alkaloid are the same as those of the crude drug (Husemann).

Antagonists and Incompatibles.—Tannic acid, by forming an insoluble tannate with the alkaloid, retards but does not prevent its absorption. When a lethal quantity has been taken, emetics and purgatives are required, and demulcents may be freely administered. Opium and the alcoholic substances antagonize the depression of the heart's action.

Synergists.—Such alkaloids as produce gastro-intestinal irritation and depress the action of the heart, e. g., *veratrine*, *aconitine*, etc., are synergistic. Therapeutically considered, emetics, purgatives, alkalies, promote the activity of colchicum.

Physiological Actions.—Colchicum imparts its virtues to water, alcohol, and ether. It has a bitter taste, and excites the flow of saliva. In small doses it increases the mucous and glandular secretion of the stomach and intestines, and probably also of the liver, kidneys, and skin. If the dose be large but still medicinal, colchicum produces a feeling of epigastric heat, nausea, and vomiting, depression of the circulation, muscular feebleness, headache. It frequently purges, producing copious watery stools, and is generally held to increase the discharge of biliary matters. It increases the flow of urine, of the solid constituents (urea, uric acid, etc.), as well as of the water, and promotes the cutaneous transpiration. In toxic doses colchicum produces all of the local as well as the systemic effects of an irritant poison, viz.: acute abdominal pain, profuse watery and choleriform discharges, suppression of urine, feeble pulse, cold sweat, coldness of the extremities. The intellect remains unaffected until carbonic-acid poisoning supervenes. The muscular cramps which have been occasionally observed are probably due to the great loss of fluid from the system. When colchicine is injected subcutaneously, gastro-intestinal inflammation is produced, showing that it has a selective action on this tissue.

This view of the action of colchicum has been fully confirmed by Dr. Roy. The strongly accentuated impression on the mucosa of the intestine is due, he affirms, to its elimination by this membrane and the profuse watery discharge as a transudation.

Therapy.—Colchicum is indicated when rapid wasting of tissue and prompt elimination of the products of waste are required. Its use at the present time is almost entirely restricted to the treatment of *gout* in its various manifestations. It relieves the pain, diminishes the swelling, and shortens the duration of an attack of *acute gout*. In order to accomplish these results, it is not necessary that the more harsh and violent physiological effects of the drug be produced. Sufficient quantity of colchicum should be given to increase secretion from the skin, the intestinal mucous membrane, and the kidneys, but nausea and vomiting should be avoided. Combination with an alkali increases the therapeutical effect of colchicum: ℞ Spts. ammoniæ aromat., ʒ xiij;

vini seminis colchici, ʒ iij. M. Sig.: *A teaspoonful every three hours, until some physiological effect is produced.* The following is a formula used at the London Hospital for gout: ℞ Tinct. colchici seminis, ♏ xx; potassii bicarbonat., grs. x; aquæ pimentæ, ℥ j. M. Sig.: *A draught.* The following modification of Scudamore's prescription is in use at University College Hospital: ℞ Tinct. colchici seminis, ♏ xv; magnesii carb., gr. vj; magnesii sulph., grs. xxx; aquæ menth. pip. ad ℥ j. M. Sig.: *A draught.* After the more acute symptoms of the gouty attack have subsided, the following was recommended by Sir Henry Halford: ℞ Ext. colchici acet., gr. vj; pulv. opii et ipecac. comp., ext. colocynth. comp., āā gr. xij. M. Ft. pil. no. xij. Sig.: One pill night and morning. The efficiency of colchicum is increased by combination with digitalis: ℞ Ext. colchici acet., gr. x; pulv. digitalis, ext. colocynth. comp., āā ℈j. M. Ft. pil. no. xx. Sig.: *One pill twice or thrice a day.*

The active principle, colchicine, is, there is reason to believe, more successful in gout than any of the preparations of the crude drug. ℞ Colchicinæ, gr. j; ext. colocynth. comp., ʒ ss; quininæ sulph., ʒ iij. M. Ft. pil. no. lx. Sig.: *One every four hours.*

In the so-called *rheumatic gout*, colchicum with alkalies is extremely serviceable. Attacks, without decided pain and inflammation, *of soreness of joints*, which have been the seat of gouty attacks, or about which nodosities have been deposited, are relieved by colchicum.

Constipation, hepatic congestion, and headache, due to torpor of the portal circulation, occurring in gouty subjects, are quickly relieved by a combination of colchicum and saline purgatives. The plethoric and overfed without being gouty, suffering from the same group of symptoms, are relieved by the same means. Inflammations of internal organs occurring in gouty subjects, for example, *gouty bronchitis* and *rheumatic pneumonia*, are best treated with prescriptions containing a preparation of colchicum. The following prescription is recommended by Greenhow in gouty bronchitis: ℞ Potassii iodidi, ammonii carbonat., āā ℈j; vin. colchici seminis, ʒ j; tinct. scillæ, tinct. hyoscyami, āā ʒ ij; aquæ camphoræ q. s. ad ℥ iij. M. Sig.: *A tablespoonful three times a day.*

Although colchicum is still advocated by some authorities in *acute rheumatism*, the general professional experience is against its use. In *chronic rheumatism*, when the joint changes are allied in nature to those which take place in gout, it is unquestionably serviceable. *Neuralgia occurring in gouty and rheumatic constitutions* is often relieved by colchicum. The indications for its use are plethora, constipation, and deficient excretion of the liver, kidneys, and skin. Colchicum relieves in such cases, by setting up an eliminative process. In *hepatic dropsy* and *cardiac dropsy*, when the patient is vigorous, the gastro-intestinal tract free from inflammatory mischief, colchicum may be used with advantage as a hydragogue: ℞ Elaterii, gr. j; spts. etheris nitrosi, ℥ ij; tinct. scillæ, tinct. colchici, āā ℥ ss; syrup. simplicis, ℥ j. M. Sig.: *A teaspoonful three or four times a day.* The following combination is an excellent diuretic in dropsy: ℞ Vini seminis colchici, ℥ ss; sol. ammonii acetat., ℥ ijss; inf. petroselin, ℥ v. M. Sig.: *A tablespoonful every four hours.* This prescription is well adapted to *dropsy following scarlatina.*

Colchicum is a serviceable remedy in certain *cerebral disorders.* Thus, it may be used in *acute cerebral congestion* in plethoric subjects, in *uræmic intoxication,* in *hypochondriasis,* especially when due to deficient elimination (uric acid, oxalate of lime, etc.).

The wine of colchicum-seed has frequently succeeded in curing *gonorrhœa,* and by Brodie a nightly dose of thirty minims was given for the relief of *chordee.* In the treatment of gonorrhœa, the following may be used: ℞ Vini colchici seminis, ℥ ss; sol. potassii citratis, ℥ vjss; tinct. opii deod., ʒ ij. M. Sig.: *A tablespoonful three or four times a day in gonorrhœa.*

Authorities referred to:

BRODIE, SIR BENJAMIN. *Works by Mr. Hawkins, Diseases of Urinary Organs,* vol. ii.

CASPAR, JOHANN LUDWIG. *Practisches Handbuch der gerichtlichen Medicin.* Neu bearbeitet und vermehrt von Dr. Carl Liman, Berlin, 1871, p. 570.

FULLER, DR. WILLIAM HENRY. *On Rheumatism, Rheumatic Gout,* etc., 1874.

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HANBURY AND FLÜCKIGER. *Pharmacographia,* p. 636.

HAMMOND, DR. W. A. *The Amerian Journal of the Medical Sciences,* January, 1859, p. 278.

HUSEMANN, DRS. THEO. AND AUG. *Die Pflanzenstoffe,* p. 493, article *Colchicin.*

ROY, DR. CH. *Archives de Physiologie, normale et pathologique.* New series, vol. v, p. 656.

Sarsaparilla.—Sarsaparilla. Root of *Smilax officinalis* and other species of smilax (Nat. Ord. *Liliaceæ*). *Separeille,* Fr.; *Sarsaparillwurzel,* Ger.

Decoctum Sarsaparillæ Compositum.—Compound decoction of sarsaparilla. (Sarsaparilla, sassafras-root, guaiacum-wood, licorice-root, mezereum.) Dose, ℥ j — ℥ iv.

Extractum Sarsaparillæ Fluidum.—Fluid extract of sarsaparilla. Dose, ʒ j — ℥ ss.

Syrupus Sarsaparillæ Compositus.—Sirup of sarsaparilla. (Sarsaparilla, guaiacum-wood, rose, senna, licorice-root, essential oils.) Dose, ʒ j — ℥ ss.

Extractum Sarsaparillæ Compositum Fluidum.—Compound fluid extract of sarsaparilla. (Sarsaparilla, licorice-root, sassafras, mezereum.) Dose, ʒ ss — ʒ ij.

COMPOSITION.—An alkaloid, *parilline*, or *smilacine*. an essential oil, starch, resin, oxalate of lime, and extractive matters. From parilline, by the action of dilute sulphuric acid, is obtained *parigenine*, a distinct alkaloid.

ANTAGONISTS AND INCOMPATIBLES.—Alkalies favor the decomposition of the decoction and fluid extracts. As there is much starch present in the drug, free iodine should not be prescribed with the official preparations.

SYNERGISTS.—Iodine, mercury, and other so-called alteratives, increase the therapeutical activity of sarsaparilla. Warm clothing increases the action on the skin; diluents favor increased urinary discharge.

PHYSIOLOGICAL ACTIONS.—Much discrepancy obtains in the opinions which have been emitted in respect to the physiological actions of sarsaparilla. Surgeons generally hold to its therapeutical powers; physicians are skeptical. The physiological experiments which have been made, both with the preparations of the crude drug and with the alkaloid, have yielded negative results. Palotta's experiments, made with the alkaloid which he had discovered so long ago as 1825, indicate that eight grains of the alkaloid produce gastric disturbance, vomiting, slowing of the pulse, depression, faintness, and sweating. These results have since been in part confirmed by Cullerier. Boecker, however, making more systematic examination in accordance with modern methods, finds that sarsaparilla is devoid of physiological activity and of therapeutical power (Husemann).

THERAPY.—From the point of view of the physiological experiments it is not difficult to understand the modern incredulity in regard to the curative power of sarsaparilla. The difficulty of distinguishing between the *post hoc* and the *propter hoc* serves to account for the belief still held in some quarters, that this drug is an *alterative*. Popularly, sarsaparilla is supposed to have extraordinary powers as a "blood-purifier," and its large use at the present time arises from this belief.

Almost the only use of sarsaparilla at the present time is in the treatment of *syphilis*. It is, of course, not adapted to the primary or to the secondary forms. The experience in its favor, even of those most confident of its powers, restricts its use to the tertiary form in debilitated subjects, who have been broken down by the combined influence of syphilis, mercurialism, and iodism. It has been further demonstrated that the best effects have been obtained by the use of large doses of the compound decoction (Allbutt). As the compound decoction contains guaiac and mezereon, it is difficult to assign the exact share of the sarsaparilla in the result. Furthermore, as a pint or more of the compound decoction must be taken in the twenty-four hours, these large draughts of a warm liquid are not without influence on the functions of the skin and kidneys. It is extremely questionable whether sarsaparilla has any therapeutic power; it is not at all equal as an alterative to some of the remedies indigenous in the United States, to be considered hereafter.

The compound fluid extract, the compound decoction, and the compound sirup of sarsaparilla, are frequently used as vehicles for iodide of potassium and for the bichloride of mercury in secondary and tertiary syphilis.

Scrofula, *chronic abscesses*, *necrosis of bones*, *old ulcers*, and *strumous cutaneous affections*, are diseases in which sarsaparilla is supposed to be efficacious. It is more used as an adjunct to more active remedies than depended on alone.

Authorities referred to:

Allbutt, Dr. Clifford. *The Practitioner*, 1870, vol. i.
Gubler, Dr. Adolphe. *Commentaires Thérap. du Codex Medicamentarius*, p. 304.
Hanbury and Fluckiger. *Pharmacographia*, p. 636, *et seq.*
Husemann, Drs. Aug. und Theodor. *Die Pflanzenstoffe*, p. 1040.

Guaiacum.—Guaiac. *Gayac*, Fr.; *Franzosenholz*, Ger.

Guaiaci Lignum.—Guaiacum-wood. The heart-wood of *Guaiacum officinale* Linné, and of *G. sanctum* Linné (Nat. Ord. *Zygophylleæ*).

Guiaci Resina.—Guaiac. A peculiar resin obtained from *Guaiacum officinale.*

Tinctura Guaiaci. Tincture of guaiac. (Guaiac, 200 grm.; alcohol, to 1,000 c. c.) Dose, ʒ ss — ʒ ij.

Tinctura Guaici Ammoniata.—Ammoniated tincture of guaiac. (Guaiac, 200 grm.; aromat. spirit of ammonia, to 1,000 c. c.) Dose, ʒ ss — ʒ ij.

Composition.—The only constituent of interest in the wood is the *resin.* Guaiac has a complex chemical composition. It contains guaiaconic acid (seventy per cent), guaiarec acid, guaiac beta-resin, guaiacic acid, guaiac yellow, gum, etc.

Antagonists and Incompatibles.—Spirits of nitrous ether and the mineral acids are incompatible.

Synergists.—Agents which promote cutaneous activity are synergistic. The action of guaiac is much aided by external warmth and warm diluent drinks.

Physiological Effects.—Guaiac has a very acid and pungent taste. It excites an abundant flow of saliva. In the stomach it creates a sensation of warmth and burning, increases the secretions of the gastro-intestinal canal, accelerates the action of the heart, promotes diaphoresis, and favors the production and excretion of bronchial mucus. In large doses it deranges digestion and causes gastric catarrh, and in excessive doses the series of symptoms produced by the irritant poisons, vomiting, purging, cramps, headache, giddiness, etc.

Therapy.—Formerly guaiac was in great repute as a remedy for *constitutional syphilis.* The decoction was drunk in large quantity, a very spare diet was enjoined, and the diaphoretic action of the remedy was aided by external warmth. Doubtless many cases were benefited by this mode of treatment, but the result was probably less due to guaiac *per se* than to the regimen.

Its present use as an anti-syphilitic remedy is confined to the preparations of sarsaparilla, in which it enters as a constituent.

Recent clinical experience has shown that guaiac is a capital remedy in *tonsillitis.* Given in a half-drachm dose (tincture) every four hours, it appears to abate the inflammation and to cut short the disease in a remarkable manner. It is a very acrid and disagreeable remedy, and should be given in emulsion, with mucilage or yolk of egg.

Guaiac is a useful remedy in *dysmenorrhœa,* when the pain is due to rheumatism or neuralgia, and is of course not adapted to those cases in which there is narrowing of the cervical canal.

Lastly, guaiac is used with varying degrees of success in *chronic gout, chronic rheumatism, lumbago, sciatica, gouty bronchitis,* etc. As we have so many more efficient and pleasant remedies for these diseases, it will rarely be necessary to resort to guaiac.

Authorities referred to:

Carter, Mr. *The Practitioner,* vol. iv, p. 190.
Flückiger and Hanbury. *Pharmacographia,* p. 92, *et seq.*
Husemann, Drs. Aug. und Theo. *Die Pflanzenstoffe,* p. 712.
Stillé, Dr. A. *Therapeutics and Materia Medica,* fourth edition, vol. ii, p. 594.

Stillingia.—Root of *Stillingia sylvatica* Linné (Nat. Ord. *Euphorbiaceæ*).

Extractum Stillingiæ Fluidum.—Fluid extract of stillingia. Dose, ♏ x — ʒ j.

(A tincture may be made of two ounces of the bruised root to a pint of diluted alcohol, of which the dose is ʒ ss— ʒ ij. A decoction may be made as follows: one ounce of the bruised root to two pints of water, boiled down to one pint, of which the dose is ℥ ss— ℥ ij. All the preparations should be made of the fresh root, as the activity of the drug is diminished by drying.)

Composition.—The plant yields on incision a milky juice, which appears to possess the medicinal properties of the drug. The so-called *stillingin* of the eclectics is not the active principle, but an extract. The active principle has not yet been isolated.

Physiological Effects.—The juice of the plant has an acrid, pungent taste, leaving a persistent after-taste of great activity. It excites an abundant flow of saliva. In the stomach a feeling of warmth follows its use, and the secretions of the organ are increased in amount. In full doses it excites nausea and vomiting, epigastric pain, and an acrid, burning sensation in the fauces. It increases the secretions of the intestinal canal, notably of the liver, and, in full doses, purges, the fæces having the appearance of the so-called "bilious stools." Increased action of the heart follows the introduction of the active principle into the circulation, and the skin becomes warm and moist. The bronchial mucous membrane exhales a larger quantity of mucus, and the kidneys become more active, excreting an increased quantity of water and solids. It may, therefore, with propriety be grouped with the so-called alteratives.

THERAPY.—Stillingia is certainly a very valuable remedy. It has long had a local reputation in the Southern Atlantic States as an *alterative.*

In *habitual constipation*, due to deficient secretion of the intestinal mucous membrane, it may be used with advantage. The *torpidity of the liver* and *jaundice*, which follow attacks of intermittent fever, are removed by stillingia. This agent also renders important service in the first stage of *cirrhosis*, and in *ascites* due to the hepatic changes. *Hæmorrhoids*, when produced by obstructive difficulty in the liver, may be removed temporarily, and, if due to constipation, may be removed permanently, by stillingia.

In habitual constipation the following formula is useful : ℞ Ext. stillingiæ fl., ʒ v ; tinct. belladonnæ ; tinct. nucis vom. ; tinct. physostigmatis, āā ʒ j. M. Sig.: *Twenty drops, in water, three times a day before meals.* When the biliary secretion is deficient, the following : ℞ Ext. stillingiæ fl., ʒ v ; tinct. aloes, ʒ ij ; tinct. nucis vom., ʒ j. M. Sig.: *Twenty drops, in water, three times a day.*

Stillingia has long been in popular repute as an alterative, and employed in domestic practice as a remedy for *scrofula in its various forms.* The success which has attended its employment in some degree justifies the high encomiums which have been bestowed on it. It is very serviceable in children who present the following symptoms: *enlarged cervical glands, muco-purulent discharge from the nose, with excoriations of the surrounding integument, a pasty complexion, capricious and unnatural appetite, tumid abdomen, whitish and pasty stools ; dull-red, soft, and tubercular eruption on the skin, ulcerating and furnishing a large quantity of unhealthy pus.* The steady use of stillingia, combined with suitable hygienic means, will accomplish important relief in such cases.

The most satisfactory results have been obtained from the use of stillingia in *syphilitic affections.* It is applicable to the same conditions under which the preparations of sarsaparilla are now used, viz., in chronic cases of the secondary and tertiary form, the patients having been broken down by the long-continued use of mercurials and iodides. Repeated observation of cases in which it was used as the sole agent has satisfied me of its curative value. It differs from the compound decoction of sarsaparilla in this, that its effect is distinctive, and is not due to the use merely of a large quantity of fluid. The eminent Dr. Porcher, of South Carolina, thus expresses himself with regard to the use of stillingia in syphilitic affections: "I have employed the decoction of the root of this plant as an alterative in syphilitic sores, occurring in patients in the City Hospital, Charleston, the spread of which nothing else could arrest. It proved completely satisfactory. Phagedenic chancres were rapidly cured under its use. A strong decoction was given three times a day, with four drops of nitric acid to each dose."

A strong infusion or decoction of stillingia is said to be effective in *preventing the development of a paroxysm of ague*, if taken before or just as the chill is beginning. It is reported that profuse diaphoresis is produced and the impending attack is averted. The fluid extract of stillingia may be given in combination with quinine or arsenic in intermittents.

Authorities referred to:

PORCHER, DR. FRANCIS PEYRE. *Resources of the Southern Fields and Forests*, Charleston, 1869, p. 146.

Sanguinaria.—Blood-root. The rhizoma of *Sanguinaria Canadensis* Linné (Nat. Ord. *Papaveraceæ*), collected in autumn. (U. S. P.)

Tinctura Sanguinariæ.—Tincture of sanguinaria. Dose, ♏ v—ʒ ss.

Acetum Sanguinariæ.—Vinegar of sanguinaria (sanguinaria, 10 parts; diluted acetic acid, sufficient to make 100 parts). Dose, ♏ v—ʒ ss. (Not official.)

Extractum Sanguinariæ Fluidum.—Fluid extract of sanguinaria. Dose, ♏ ij—♏ xx.

COMPOSITION.—Sanguinaria contains an alkaloid, *sanguinarine*, which appears to be identical with the *chelerythrine* of Probst. Sanguinarine is a white, pearly substance of an acrid taste, very sparingly soluble in water, soluble in ether, and very soluble in alcohol. With the acids it forms salts soluble in water, all of which have some shade of red, crimson, or scarlet, and form beautiful red solutions. Another alkaloid, named *porphyroxine* (sanguinaria-porphyroxin—Husemann), has been found by Riegel. Besides these alkaloids, sanguinaria contains a peculiar acid, *chelidonic*, and another has been announced, for which the name *sanguinarinic acid* has been proposed, but this latter acid has been shown to be a mixture of malic and citric acids. The alkaloids exist in the root in combination with these acids—the most important compound being the *chelidonate of sanguinarine*. Besides the foregoing, blood-root contains the following unimportant constituents: resin, gum, extractive, albumen, sugar, etc.

Antagonists and Incompatibles.—Alkalies, tannic and gallic acids, and most of the metallic salts, are chemically incompatible with the preparations of blood-root. The local irritant action of the drug and the depression of the circulation which it causes are antagonized by opium, by amyl nitrite, by atropine, etc.

Synergists.—The mineral and vegetable emetics, the so-called alteratives of the vegetable kingdom, and the mineral salts, considered from the therapeutical point of view, promote the physiological and therapeutical effects of sanguinaria.

Physiological Effects.—Sanguinaria has a bitter, acrid taste, which persists for a long time. When swallowed, it leaves a sense of constriction and acridity in the throat. It excites a feeling of heat in the stomach, and stimulates secretion of the mucous membrane. If the quantity taken is insufficient to produce nausea, the action of the heart is increased, and a subjective sensation of warmth is experienced throughout the system. In considerable doses sanguinaria is an active emetic, producing much nausea and depression, and slowing the action of the heart. It is very irritating to the mucous membrane. Snuffed up the nose, it produces violent sneezing. In large doses it inflames the stomach, producing intense burning, with thirst, great prostration, dimness of vision, vertigo, and collapse.

The alkaloid, *sanguinarine*, manifests all the physiological capabilities of the drug. It has an intensely bitter, acrid taste. In small doses (one twelfth to one eighth of a grain) it simply increases secretion of the gastro-intestinal mucous membrane ; in doses of one sixth to one fourth of a grain it causes depressing nausea and sometimes vomiting. In large doses it produces, in addition to the gastric symptoms mentioned above, slowing and irregularity of the pulse, cold sweats, cold extremities, vertigo, dilated pupils, anxiety, etc.

Applied to fungous granulations, sanguinaria has considerable escharotic power.

The sketch above given of the physiological actions of sanguinaria, which embodies the results of the author's investigations and clinical studies, requires no special modification. The recent elaborate and most thorough research of Dr. Robert Meade Smith confirms the author's account. The reader who wishes to exhaust the subject will find that nothing has been omitted by Dr. Smith.

Therapy.—In *atonic dyspepsia* from two to five drops of the tincture, or the one twelfth of a grain of sanguinarine, may be used with advantage. It promotes secretion, and increases the appetite. There seems no doubt, according to the author's observation, that sanguinaria promotes the hepatic and intestinal secretions. It is, therefore, a serviceable remedy in *duodenal catarrh, and secondary catarrh of the biliary ducts with jaundice.*

Its most important therapeutical effects are witnessed in *diseases of* *the respiratory organs.* *Chronic nasal catarrh* is successfully treated by the internal use of the tincture (ten drops *ter die*), or of the alkaloid (one fifteenth of a grain *ter die*), and the local application of the powder, in small quantity, applied by an insufflator to the Schneiderian mucous membrane. In *acute bronchitis* (catarrh), after the subsidence of the more acute symptoms, it is a serviceable expectorant. It may be combined with other expectorants and alterants: ℞ Tinct. sanguinariæ, ʒ j; tinct. lobeliæ, ʒ j; vini ipecac., ʒ ij; syrup. tolutan., ℥ ss. M. Sig.: *A teaspoonful every three hours as an expectorant.* In *humid asthma* the following combination is extremely serviceable: ℞ Tinct. sanguinariæ, ʒ j; tinct. lobeliæ, ʒ j; ammonii iodidi, ʒ j; syrup. tolutan., ʒ vj. M. Sig.: *A teaspoonful every two, three, or four hours.* In *spasmodic asthma* the same prescription is occasionally very effectual, but the author is unable to indicate the precise condition under which it is most useful.

Sanguinaria has been proposed as an *emetic in croup.* It is, however, too uncertain in action, and too harsh, to justify its use when there are so much more eligible remedies at hand.

The *emmenagogue properties* of sanguinaria seem well established. It is indicated when *amenorrhœa* is functional in character, when there is an absence of plethora, and when no malformation exists. It may be advantageously combined with aloes, provided there is no contraindication to the use of the latter. ℞ Tinct. sanguinariæ, ʒ ij; tinct. aloes, ℥ ss; tinct. nucis vom., ʒ ij. M. Sig.: *Twenty drops two or three times a day, in amenorrhœa of anæmia, or chlorosis.* Or the following: ℞ Sanguinarinæ, grs. ij; ext. aloes, grs. x; ferri redacti, ℈ j. M. Ft. pil. no. xx. Sig.: *One pill three times a day.*

Sanguinaria has decided *aphrodisiac properties.* When there are relaxation of the genital organs, diurnal losses, inaptitude (from irritability) for coitus, *sanguinarine* may be given as follows: ℞ Ergotin (aq. ex.), ℈ j; sanguinarinæ, grs. ij. M. Ft. pil. no. xx. Sig.: *One, three times a day.* As stillingia appears to have similar properties as an aphrodisiac, the following combination will prove useful: ℞ Tinct. sanguinariæ, ʒ iij; ext. stillingiæ fl., ʒ v. M. Sig.: *Fifteen to twenty drops, in water, three times a day.*

As an alterant in *chronic syphilitic* and *strumous affections*, sanguinarine may be used in the same class of cases as sarsaparilla, guaiac, and stillingia. It is an important addition to a decoction of woods indigenous to our soil, used as a substitute for the more expensive and really less efficient foreign drugs of the same group.

Local Applications.—Sanguinaria, having feeble escharotic property, is used as a local application *to repress exuberant granulations*, and to *ill-conditioned ulcers* to change their character. Several cases have been reported, indicating the power of sanguinaria to repress the growth and destroy *nasal polypi.*

A decoction of sanguinaria is a useful gargle in the *sore-throat of scarlatina.*

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Xanthoxylum.—Prickly ash. The bark of *Xanthoxylum americanum* Miller and of *X. clava-Herculis* Lambert (Nat. Ord. *Rutaceæ, Xanthoxyleæ.*)

Extractum Xanthoxyli Fluidum.—Fluid extract of xanthoxylum. Dose, ♏ x—ʒ j.

A decoction may be made by boiling an ounce of the bark in a quart of water down to one pint, and of this one to two ounces may be used every four hours. A tincture may also be prepared with two ounces of the root to a pint of diluted alcohol, of which the dose would be ʒ ss—ʒ ij. The official fluid extract is more frequently in use; the dose of this is ♏ xv—ʒ ij.

COMPOSITION.—Xanthoxylum contains a neutral crystallizable principle, which is known as *xanthoxylin*, and is said to be identical with *xanthopicrite*, and the latter has been shown to be *berberine*. Besides this important constituent, a volatile and a fixed oil, resin, gum, etc., are contained in it.

PHYSIOLOGICAL ACTIONS.—The taste of xanthoxylum is at first sweetish, and somewhat aromatic, but considerable bitterness is soon developed, followed by acridity, which remains long in the fauces. It has remarkable sialagogue property, and the increased flow of saliva occurs from the systemic effects, as well as from the local impression on the mucous membrane of the mouth. In the stomach it excites a sensation of warmth, and increases secretion from the stomach and intestinal mucous membrane. It is in a high degree probable that just as its presence in the mouth causes salivation, so its presence in the intestinal canal determines the flow of gastric, duodenal, hepatic, and pancreatic secretion. The action of the heart is increased by xanthoxylin, the arterial tension rises, the capillary circulation becomes more energetic, and the sweat-glands are made to pour forth a more abundant secretion. Corresponding effects are produced in the kidneys, and increased flow of urine follows its administration.

THERAPY.—Xanthoxylum is a domestic remedy for *toothache.* The bark, chewed, has a popular reputation for *paralysis of the tongue.* A decoction of the bark is an efficient local application to the throat when, in cases of *chronic pharyngitis*, there is dryness of the mucous membrane. From ten to thirty minims of the fluid extract, or a half to one drachm of the tincture, *ter in die*, is a successful remedy for an extremely obstinate affection, namely, chronic pharyngitis—the mucus adhering in large, thin, dry scales, and the mucous membrane being glossy, shining, glazed, and dry.

The active principle (xanthoxylin) is a useful *stomachic tonic* in atonic dyspepsia. When, however, in stomach, intestinal, or hepatic disorders the object is to promote secretion, the preparations of xanthoxylum must be used. *Jaundice due to catarrh of the bile-ducts*, and that form of *jaundice produced by acute malarial poisoning*, are conditions in which xanthoxylum is distinctly remedial. *Constipation, due to deficient secretion*, is also removed by this agent.

Xanthoxylum has long had a deserved reputation in the treatment of *chronic rheumatism*. It is adapted to *muscular rheumatism, myalgia*, and such local muscular disorders as *torticollis* (recent cases), *lumbago*, etc. It may be used with advantage, locally, in these affections. The curative power which it possesses in chronic rheumatism is doubtless due to its eliminant action on the mucous and cutaneous surfaces.

Xanthoxylum is a remedy for *constitutional syphilis* of equal merit with guaiac, mezereon, stillingia, etc., and is greatly more effective than sarsaparilla.

Decoction of xanthoxylum has been used with success in the treatment of *dropsy*.

Fraxinus Americana.—The inner bark of the root. (Not official.)

Preparation.—*Vinum Fraxini*. The inner bark of the root collected in November, eight ounces; stronger white wine, or sherry, two pints. The root-bark should be macerated in the wine three or four days; after percolation, to every 25 parts there should be added 2 parts of glycerin and 1 part of alcohol. The dose of the wine thus prepared is a teaspoonful or two, three times a day, before meals.

Actions and Uses.—There has been no adequate study of the physiological actions of fraxinus. Its employment is, thus far, merely empirical. We owe to Dr. Charles P. Turner, of Philadelphia, the knowledge now in our possession regarding its therapeutical powers. It belongs to the group of alterative medicines, if we may still use this rather obsolete term. Administered in certain diseases, it modifies the local morbid process, or cures it without any recognizable disturbance of the functions. The chief use of it thus far has been in the treatment of certain uterine disorders. Dr. Turner has found it to have a curative action in *chronic metritis*, and in the disorders consequent on this condition of the uterus. In the various forms of *dysmenorrhœa*, especially the congestive variety, it has proved to be very effective. Lest disappointment may be experienced from its use, Dr. Turner assures us that the administration of the wine must be kept up for several weeks or months. When administered for dysmenorrhœa, it should be taken diligently in the interval, and, when given for metritis, it should be taken assiduously for several months. How much is due to time, and how much to the remedy, has not been shown.

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Viburnum Opulus.—Cramp bark. The bark of *Viburnum opulus* Linné (Nat. Ord. *Caprifoliaceæ*).

Viburnum Prunifolium.—Black haw. The bark of *V. prunifolium* Linné (Nat. Ord. *Caprifoliaceæ*).

Extractum Viburni Opuli Fluidum.—Fluid extract of viburnum opulus. Dose, ♏ x — ʒ ss — ʒ j.

Extractum Viburni Prunifolii Fluidum.—Fluid extract of viburnum prunifolium. Dose, ♏ x — ʒ ss — ʒ j.

COMPOSITION.—According to Hermann Allen, besides a bitter brown and yellow resin, viburnum contains *viburnine* (Kramer), an active principle. This principle has not been utilized in medical practice.

ACTIONS AND USES.—Recently, Dr. Theodore Sperman, of Edinburgh, has made the viburnums the subject of physiological investigation. He confirms the existence of an active principle, which, however, is present in small amount (½ per cent). That this alkaloid represents the powers of viburnum, he was successful in determining by experiment on animals, producing the same effects in them by its administration as he had caused by the crude drug. The active principle is a sedative, slows the heart-beat, and lowers the vascular tension, the cardiac movements being arrested in the diastole. It induces drowsiness, lessens reflex activity, and causes paresis of the muscular system and inco-ordination of movements. The experiments on animals were confirmed by observations on man. Some drowsiness, sluggishness of movement, lowering of the blood pressure, diminution of sensibility, and lessening of the reflexes result from its administration in full doses to the human subject. Toxic symptoms were not caused by large doses. The headache and disturbances of vision noted by some observers in the course of its medicinal administration did not happen in the cases studied by Dr. Sperman. There is, however, a general agreement that viburnum is not an active substance. No obvious effects were produced in guinea pigs by considerable doses (Monelar). Wilson, of Liverpool, reports dryness of the mouth, disorders of vision, and general numbness as a result of the action of strong doses. Jenks, of Detroit, maintains that it has a special action on the uterus through the sympathetic system of nerves; that it is a uterine sedative. This is a pure assumption, and rests entirely on the supposed power of viburnum to prevent abortion when threatened, and to prevent or arrest the pains of dysmenorrhœa. It is indicated in cases of *habitual abortion* in which it may be supposed an irritable state of the uterus exists, so that uterine action sets in at a certain stage of development of the fœtus. When the fœtus has died, or utero-placental hæmorrhage has taken place, this remedy has little influence over the result. In *uterine colic* and *after-pains* there are numerous reports of its good effects. It has also proved useful in the treatment of dysmenorrhœa. Experience has shown that it acts more efficiently when administered for some days—a week or more—in anticipation of the menstrual flow. According to Jenks, Monelar, and others, it is a valuable remedy for the *menorrhagia* of the menopause. In a variety of uterine maladies accompanied by excessive and too frequent menstrual flow this remedy is held to be an efficient agent for relief. So many pathological states are represented in the chief symptom that it may be doubted whether viburnum has any real power over them, and it can be claimed only that it affects favorably and restrains the hæmorrhagic tendency. It is the author's judgment that the remedy has been greatly overrated by its advocates, but he admits it to a place in this work because it has been added to the list of the U. S. Pharmacopœia.

It is in a high degree probable that the viburnum opulus is more effective than the V. prunifolium. The fluid extract is the official representative of both.

REMEDIES USED TO DESTROY MICROBES OR MORBIFIC GERMS, AND TO PREVENT OR ARREST SEPTIC PROCESSES (ANTISEPTICS, OR GERMICIDES).

ANTISEPTICS.

Those remedies are entitled *antiseptic* which are employed to arrest fermentative processes. It is now generally admitted that every kind of fermentation is correlative of the growth and multiplication of a living organism. In various diseases, microzymes, vibrio, bacteria, either stand in a causative relation to the morbid process, or are necessary to its evolution and development.

To illustrate the commanding importance of pathogenic organisms in modern pathology, it is only necessary to mention a few of the more noteworthy discoveries in the new science of bacteriology—for example, the *spirochaete plicatillis* of relapsing fever, the *bacillus of tubercle*, the *coccus* of pneumonia, the *comma bacillus* of cholera, etc. The mere finding of minute organisms does not suffice to prove that their presence is anything more than accidental. To demonstrate a causative relation, cultures of the organism, and afterward successful inoculations, are requisite.

Very admirable practical results have followed the discovery of the alkaloid-like *ptomaines* in the intestinal canal. Fermentative processes set up by germs introduced from without produce these substances when the local conditions are favorable. The formation of *ptomaines*, and of such actively poisonous substances as *tyrotoxicon*, correspond to or imitate methods by which the active principles of plants are produced. Increasing experiences, and the accurate scientific methods now applied to the whole question, have demonstrated that various maladies—some supposed to be constitutional in character—are due to these poisons, which, when formed, diffuse into the blood, setting up the morbid process characteristic of each agent.

The remedies of this group—antiseptics—have the power, when brought into contact with the minute organisms or disease-germs mentioned above, to destroy their vitality, and to arrest the fermentation process, or zymosis, which they either initiate or promote. There is a distinct relation between the antiseptic and antipyretic properties of various members of this group, and they have the power to depress temperature in the same ratio that they are active in destroying disease ferments and germs. Some of these remedies, e. g., quinine, sulphurous acid, the sulphites, etc., have already been discussed in Part II. Under this head there remain for consideration several important agents whose applications are distinctly antiseptic.

Oxygenium.—Oxygen. *Oxygène*, Fr.; *Säuerstoff*, Ger. (Not official.)

Preparation.—The most convenient mode of preparing oxygen for medical purposes is to heat in a gun-barrel-shaped brass or iron retort a mixture composed of five parts of chlorate of potassium and one part of binoxide of manganese. When heated to dull red, the chlorate yields up its oxygen, being reduced to chloride. The gas may be most conveniently collected over water, which dissolves but little of the oxygen, but takes up all the chlorine that may be accidentally present.

It is a permanent, elastic gas, inodorous, without taste, incombustible, but uniting with bodies in a state of combustion. It is very slightly soluble in water at the ordinary temperature and pressure.

Dose.—The quantity of oxygen which may be inhaled, in the ordinary medicinal applications of this gas, ranges from one to five gallons. The simplest apparatus will suffice, but an elastic bag, with a suitable mouth-piece, is usually employed for this purpose.

Physiological Actions.—If the important *rôle* which oxygen plays in the economy of Nature furnished a measure of its powers when administered as a remedy, it would be a most important therapeutic agent. When inhaled in the pure state (not as air), it produces singularly little constitutional disturbance. A sensation of warmth in the larynx, trachea, and bronchi, is first experienced; the pulse, as a rule, somewhat increases, though it may be lessened in frequency; a sense of mental exhilaration and a disposition to greater bodily activity are produced; the appetite becomes keener; but no constant influence on the excretions has been noted (Demarquay). Experiments on animals have demonstrated that the inhalation of oxygen *per se* does not have an injurious effect on animal life (A. H. Smith). On the contrary, as Hayem has recently shown, the administration of oxygen in from forty to ninety litres per day, given in two doses and mixed with a determinate quantity of air, energizes to a considerable degree the nutritive functions; it increases the appetite, slightly elevates the temperature, stimulates the cardiac movements, and augments the body-weight. These results are due in the main to the effect of oxygen on the blood; it increases the number and stimulates the organic activity of the red blood-globules. Although this action is not constant, the effects may become so by the greater nutritional changes which are thus promoted. When the inhalations are suspended, these effects on the blood cease. Anne's results, obtained by a course of experiment on himself, entirely confirm those obtained by Hayem.

Therapy.—Oxygen is indicated and has been used with success in diseases of the respiratory organs, characterized by *dyspnœa*, due to causes interfering with the oxygenation of the blood, in *emphysema*, *asthma*, *croup*, *asphyxia*, *chloroform narcosis*, *asphyxia from toxic gases*, etc. In these cases oxygen acts in a manner which is perfectly obvious: the labor of breathing and the damage to the respiratory center are lessened by the addition to the blood of oxygen in larger quantity than is supplied by the air. In these cases, pure oxygen, or a mixture of one part of the gas to two or three of air, may be employed. The more extreme the dyspnœa, the greater the necessity for undiluted oxygen.

Oxygen is also indicated, and has been successfully employed, in certain diseases characterized by insufficient oxidation: *chlorosis*, *anæmia*, *leucocythemia*, *diabetes*, *albuminuria*, etc. In such cases the internal administration of chalybeate medicines, or mineral waters, should accompany the inhalations of oxygen. Pure oxygen is not necessary; an admixture with three parts of air will suffice, and the inhalation should be made morning and evening.

The evidence is satisfactory that oxygen-inhalations produce good results in some cases of *phthisis*. Those cases appear to be most benefited in which emaciation, dyspeptic symptoms, etc., have occurred, without marked change in the condition of the lungs. When hectic fever comes on, and excavations have occurred, the utility of oxygen has ended, except as a palliative of dyspnœa. Pinard reports a case of *vomiting of pregnancy*, uncontrollable by other means, promptly arrested by oxygen inhalations. Hayem gives similar facts, and also reports the good effects of this remedy in *gastralgia, dyspepsia*, and other functional disorders of the stomach. In *cancer, chronic catarrh*, and dilatation of the stomach, it affords relief without having a curative action.

Ozone.—Active oxygen.—*Hydrogen Dioxide.*

The peculiar odor of ozone explains the name given it by its discoverer, Schönbein, who long maintained alone the genuineness of this form of oxygen. It is now agreed by chemists that it is an allotropic modification of oxygen, in which three atoms are condensed into two.

The medical properties of ozone have been most successfully studied by Binz. It is an active oxygen, a powerful oxidizing agent, and therefore is so destructive as to be dangerous to handle. The tissues of the human body are affected by it in a peculiar manner. It sets up an acute catarrh of the respiratory mucous membrane if breathed in quantity. The coagulability of albumen is destroyed by it. It has been asserted that it causes pneumonia under certain unknown conditions.

Binz finds that ozone is a cerebral sedative, that it induces drowsiness and stupor; but this must be secondary to a primary stimulant effect, and may be due to changes in the protoplasm, on which it acts with great energy.

Aqua Hydrogenii Dioxidi.—Solution of hydrogen dioxide. Peroxide of hydrogen. "A slightly acid, aqueous solution of hydrogen dioxide, containing, when freshly prepared, about three per cent by weight of the pure dioxide, corresponding to about ten volumes of available oxygen." Barium dioxide, 300 grms., and a sufficient quantity of phosphoric and sulphuric acids with distilled water are the materials from which it is prepared. The resulting solution is a colorless liquid, without odor, slightly acidulous to the taste, and producing a peculiar sensation in the mouth, with a soapy froth. It loses its strength by keeping.

This official preparation may be prescribed by dilution with water, one fourth to one sixth, and the dose is f ʒ j—f ℥ ss.

Hydrogen dioxide is a powerful oxidizing agent, and is therefore destructive of organic poisons and pathogenic organisms. It acts on the gases of decomposition and thus removes foul odors. It has been proved to possess the power to destroy the bacilli of charbon and the microbes of typhoid, cholera, diphtheria, and scarlet fever. It is therefore a powerful antiseptic application, and of great value in the treatment of *diphtheria* wherever it can be brought in contact with the morbid process. By means of a nasal syringe, it can be applied, diluted one half, to the nasal passages, or undiluted in spray, or by means of a probang to the throat. In *scarlet fever*, for the throat and nasal manifestations, it is a valuable means of relief. In *gonorrhœa* it is an excellent injection, destroying the gonococcus and arresting the formation of pus. According to the severity of the symptoms, it may be used in the strength of the official solution or diluted one half or one fourth. It is a good application to *soft chancre*. For suppurating *cavities*, discharging *abscesses*, *sinuses*, etc., it can be injected freely, destroying foul odors and stopping suppuration.

It is one of the most convenient and least objectionable applications for disinfecting the hands and instruments. For bleaching the hair it is a safe and efficient means. Being an active oxidizing agent, and rapidly losing its properties in contact with organic matter, systemic effects can hardly be produced by it in nearly the same degree. The effects which have been claimed for it as a remedy in various constitutional states are not supported in recent experiences. That its action must be regarded as confined to the point of contact is proved by the effects which ensue there: it coagulates albumin, effervesces freely, and covers the ulcerated surface with a whitish coating. In contact with the mucous membrane a similar action takes place, and this means the more or less complete disintegration of the dioxide, whence it follows that the strong claims put forth regarding its antiseptic powers must be modified. The remarkable assertions published, and which have been embodied in the above remarks, are for the most part based on theoretical considerations.

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Chlorinium.—Chlorine. *Chlore*, Fr.; *Chlor*, Ger. (Not official.)

Properties.—Chlorine is a greenish-colored gas, of a persistent, penetrating, suffocating, and characteristic odor. It is soluble in water in the proportion of two volumes (of gas) to one.

Aqua Chlori.—Chlorine-water is a greenish-yellow liquid, possessing the suffocating odor of chlorine.

Liquor Sodæ Chloratæ.—Solution of chlorinated soda. A transparent liquid, of a greenish-yellow color, having a slight odor of chlorine, a sharp, saline taste, and an alkaline reaction.

Calx Chlorata.—Chlorinated lime. Chloride of lime. A grayish-white substance, in powder or friable lumps, dry or but slightly moist, and nearly entirely dissolved by dilute muriatic acid, with the escape of chlorine. It should contain at least 25 per cent of chlorine.

PHYSIOLOGICAL ACTIONS.—Chlorine as a gas, or in solution in water, is an active irritant. Applied to the skin for some minutes, it causes heat and burning, increased diaphoresis, and, if the contact be sufficiently prolonged, vesication. Inhaled in very small quantity, largely diluted with air, this gas induces a sensation of warmth in the chest, and increases the bronchial mucus. In considerable quantity it is a violent irritant, excites spasm of the glottis, and sets up active inflammation of the larynx, bronchi, and lungs.

Chlorine is without action when moisture is not present. Water is decomposed by it, chlorhydric acid is formed, and oxygen set free as active oxygen or ozone. The antiseptic properties of chlorine are, therefore, due in large part to the oxidizing powers of the liberated ozone. The sulphur and phosphorus compounds with hydrogen are decomposed by chlorine. When this gas is brought into contact with sulphureted hydrogen, chlorhydric acid is formed and sulphur is precipitated. On these chemical facts rest the deodorant and disinfectant powers of chlorine. Binz has lately made an elaborate study of the effects of chlorine, and he finds that in animals it has a distinct narcotic effect ; that it suspends the functions of the cerebrum, but does not impair the contractility of muscle, or the irritability of nerves.

THERAPY.—Chlorine gas will arrest putrefactive decomposition of animal matters, and may, therefore, be employed as a preservative of *anatomical preparations.* As a deodorant and disinfectant it may be used to destroy *foul effluvia* and *disease-germs.* It is irrespirable in sufficient quantity to affect disease-germs in the living subject, and it destroys the colors and even texture of fabrics, so that it is rarely used for disinfection of the person or of the clothing of patients.

Chlorine-water, chlorinated soda, and solutions of chlorinated lime are employed locally in *scarlet fever, diphtheria, aphthæ,* and *gangrene of the mouth and fauces.* Their chief utility consists in removing fetor, but they probably, also, exert a toxic influence on disease-germs. ℞ Aquæ chlori, ℥ ss ; aquæ destil., ℥ iij ; syrupi simpl., ℥ ss. M. Sig.: *As a gargle or lotion for the mouth.* R Calcis chlor., ʒ ss ; mucilaginis, ℥ ss ; aquæ destil., ℥ iijss. M. Sig.: *Lotion.* To correct fetor of the breath, the following formula may be used: ℞ Calcis chlorat., ʒ iij; aquæ destil., alcoholis, āā ℥ ij; ol. rosæ, gtt. iv. M. Sig.: *A teaspoonful to a tumblerful of water.*

Chlorine-water was formerly much employed in *scarlet fever, typhoid, typhus*, etc. Its use in these affections was predicated on its power to arrest the growths and development of the morbid ferments. It need hardly be stated that such notions are no longer entertained.

These chlorine preparations are unquestionably serviceable as detergent, deodorant, and antiseptic applications to *sloughing and gangrenous wounds.* A solution of chlorinated soda is employed to prevent infection by animal poisons, the *bite of serpents and insects*, and the *syphilitic virus.*

Formerly chlorine-water and chlorinated soda were used in *chronic hepatic affections*, but there is no evidence that they are serviceable.

The toxic effects of chlorine gas may be prevented by ammoniacal gas, forming ammonium chloride. Albumen is the most suitable and convenient antidote to the chlorine preparations taken into the stomach. It should be given freely in the form of milk, eggs, flour, etc.

Bromum.—Bromine. *Brome*, Fr.; *Brom*, Ger. A dark-red liquid, having a strong, disagreeable odor. It is sparingly soluble in water, more soluble in alcohol, and still more so in ether.

Physiological Actions.—The actions of bromine, considered from the chemical point of view, are similar to those of chlorine: it decomposes hydrogen compounds, forming bromhydric acid, and precipitating or separating the element associated with hydrogen. It is therefore a deodorant and antiseptic. The vapor of bromine is intensely irritant to the air-passages. It combines with the water and sets free ozone, which energetically attacks the mucous membrane. In sufficient quantity, laryngitis, bronchitis, and pneumonia will be produced by the inhalation of its vapor. Applied in the liquid form, and undiluted, bromine acts as an energetic and very painful escharotic. A brownish slough is formed, which is afterward slowly detached. Internally, by the stomach, bromine acts as a corrosive poison, producing violent gastritis, and the phenomena of depression and collapse, which attend the action of corrosive poisons in general.

Therapy.—The vapor of bromine is an efficient remedy in *acute coryza* and *hay-asthma:* ℞ Bromi, ʒ ss; alcoholis, ℥ iv. M. Sig.: *For inhalation.* A small quantity of this solution may be placed in a wide-mouthed vial, and vaporized by the warmth of the hand. The vapor should be snuffed into the nose. It probably acts, as already explained, by setting free ozone. The activity of the pollen of plants, the presence of which gives rise to the symptoms of hay-asthma, is destroyed. The offensiveness of an *ozæna* may be removed by the same expedient. *Chronic nasal catarrh* may not unfrequently be greatly benefited by the vapor of bromine. Hammond has proposed the internal use of a solution of bromine, as a substitute for the bromides in the treatment of *epilepsy*. Besides its disagreeable qualities, and its irritant action, it has no advantages over the bromides.

The most important use of bromine is as an escharotic. For the destruction of *chancre*, it is probably the best caustic. *Hospital gangrene*, the experience of the rebellion demonstrated, was more certainly arrested by bromine than by any other escharotic.

For the destruction of *carcinoma uteri*, this agent is preferred by some eminent gynæcologists. When used for these purposes, pure bromine is applied, by means of a glass rod, thoroughly, to the diseased or sloughing or gangrenous surface.

The objections to the use of bromine are its fetid odor, its volatility (boils at 117° Fahr.), and the pain which attends its escharotic action.

Gaseous Enemata and Inhalations.—Although some observations have been made on this topic (pages 8 and 9), the remarkable development the method has undergone, and the absorbed attention given to the whole subject by the medical profession and the public, seem to require that some additional information be laid before our readers.

Rectal injections of gas, as now employed, we owe to Bergeon, of Lyons, France. It is a curious fact, however, that the method is a mere revival of a practice carried on about a century ago. Fallen into complete oblivion, the practice has been revived by a set of circumstances rather accidental than designed. Rectal injections are among the measures utilized at medicinal springs to procure the maximum effects from the waters, especially of those, like the sulphurous, that are disagreeable to the sense of taste. It was ascertained that the gases contained in these waters—carbonic-acid and sulphydric-acid gases—are the constituents that accomplish the good effects observed in cases of phthisis, and hence the next step consisted in the application of the gases themselves. The experimental observations of Bernard were then recalled, and also his explanation of the remarkable fact that these gases thrown into the rectum escape by the lungs, and do not therefore reach the cerebro-spinal centers. Further historical researches have brought to light the observations made toward the close of the eighteenth century, and every point almost is found to be completely anticipated. Priestley, the discoverer, and Beddoes and Percival, the clinicians, are thus disclosed to us as having used the same gases, by the same method, and for the same disease. Dr. Bergeon has invented a useful contrivance for making, washing, storing up, and injecting the gases, and in an incredibly short time his method and apparatus have been employed in all civilized countries.

It need hardly be formally asserted that improvements, or, at least, modifications in the method, have been proposed. The *inhalation* of the same gases has been substituted for the injection, by Dr. Dupont, of Lyons, and with manifest advantage. The sedative effects of carbonic-acid gas, and the germicide action of sulphureted hydrogen, are obtained directly by inhalation, and without the need of apparatus. There is, however, now, a material having active germicide powers, which is applied by inhalation with entire facility. We refer to the combination of gases, liquefied, known as "Pictet liquid." It consists of sulphurous-acid and carbonic-acid gases, liquefied by a pressure of three atmospheres, and stored in siphon bottles. When the valve of the bottle is opened the gases escape, and so intense is the cold caused by the rapid evaporation that a part of the carbonic anhydride is frozen into snow. Pictet liquid is a powerful germicide, and hence its utility in affections of the broncho-pulmonary tract, and to prevent the development—the pullulation—of the *bacillus tuberculosis.* If the reader will refer to the article on sulphurous acid, he will find there some observations on the powers of this substance as a remedy in tuberculosis, and on the comparative safety of its inhalation.

So powerful a preparation as the Pictet liquid must be inhaled with care and discretion, but, as pyridine is inhaled, this liquid can be. A closet, or room of small dimensions, which can be closed, is selected; all carpets, hangings, bedding, and furniture, except a small table and chair, are removed; the slightest pressure on the valve permits a little gas to escape, and diffusion through the air of the room then occurs. As, indeed, only the patient can judge accurately of the effect produced, he should be instructed to permit the gas to escape in very minute quantity until the amount desired is obtained. A peculiar brassy taste, a slight sense of constriction of the throat, a little cough, and a faint feeling of oppression, are the effects to be obtained and to be kept up for an hour or two at each sitting, twice or three times a day. If begun with caution, and conducted with discretion, the very best results may be expected.

Sufficient experience has now been had to enable a judgment to be formed of the real value of gas enemata in the treatment of pulmonary diseases. There are, and have been from the first, several embarrassing considerations in the way of correct conclusions. The novelty of the expedient, the high claims put forth, the reported cures, and sudden enthusiasm, inflamed alike the imaginations of patient and physician, and a sober estimate of the actual value of gas-injections was well-nigh impossible. Thus much may be maintained as true, however—many patients are quickly benefited, cough, expectoration, fever, and sweats subsiding, while the appetite improves, and the general condition grows rapidly better; but it is found presently that the bacillus does not disappear, and that the improvement is more apparent than real, is not maintained, and that the continued use of gas-injections becomes irksome, at last impossible. In not a few instances the practice can not be carried out because of the local irritation; and there are many phthisical subjects not amenable to the method at all, or have a natural inaptitude that admits of no training. There appears to be a growing conviction that those phthisical subjects who have experienced much benefit from the treatment owed this result to the influences so strongly affecting the imagination of both patient and practitioner.

Various examples of *asthma*, of *emphysema*, and of *chronic bronchitis* have been reported cured, but the fallacy underlying these statements is only too obvious. Spasmodic asthma—the *neurosis*—it is probable, can be cured, and a single gas-injection might suffice; but the conditions are greatly different in the other maladies, and, although very striking improvement may be witnessed, cures do not necessarily follow, nor, indeed, have they been effected. After a candid survey of the whole subject, the author finds himself in this attitude—that the inhalation of gases is a more rational, effective, and convenient method of treating pulmonary diseases than by rectal injections.

Besides the gases referred to in this section there are certain vaporizable liquids and solids that are utilized in the treatment of pulmonary affections by the method of inhalation that will be considered elsewhere in this work. Under their respective heads observations on such vaporizable liquids as *pyridine*, *carbon sulphide*, *ethyl-iodide*, and *ethyl-bromide* will be found, and the attention of the reader is therefore directed to them. Such vaporizable solids as iodine and iodoform are also available for the method of inhalation, but they require a special arrangement for converting the solid into vapor by means of heat. Various special contrivances exist for producing effects of a similar kind, when chloride of ammonium is formed by the union of the vapors composing it.

Referred to, for gas injections:

Beddoes, Dr. Quoted by Dupont.
Bergeon, Dr. *Bul. Gén. de Thérap.* Various articles during 1886 and 1887.
Dujardin-Beaumetz. *Bul. Gén. de Thérap.* November, 1886.
Dupont, Dr. Maurice. *Bul. Gén. de Thérap.* January 15, 1887.
Durand-Fardel, Dr. Quoted.
Minot, Dr. Francis. *The Medical Record* for 1887.
Paul, Dr. C. *Apparatus for Gas Injections.*
Percival, Dr. *On Fixed Air.* 1768.
Priestley, Dr. *Experiences with Different Kinds of Fixed Air.* 1774.

Acidum Carbolicum.—Carbolic acid. *Phénique acide*, Fr.; *Carbolsäure*, Ger. A product of the distillation of coal-tar. Is either in acicular crystals or in crystalline masses; white or colorless when perfectly pure, but, even when slightly impure, either reddish or becoming so on exposure; deliquescent and readily assuming the liquid state in the presence of a little water, yet not dissolving; of a strong odor and taste, recalling those of creosote, but distinct; fusible at from 93° to 106°, forming an oily liquid. It is soluble in from twenty to thirty-three parts of water, the purest being most soluble. Alcohol, ether, chloroform, glycerin, and the essential oils, dissolve it freely. It combines with alkalies and other salifiable bases, but its compounds have still an alkaline reaction and are decomposed by the feeblest acids, even by carbonic acid. Dose, gr. ¼—gr. j.

Acidum Carbolicum Crudum.—Impure carbolic acid. Is either colorless or has a brown shade. It consists of carbolic and cresylic acids, in variable proportion, with impurities derived from coal-tar, which vary from ten to thirty per cent.

Glyceritum Acidi Carbolici.—Glycerite of carbolic acid. (Twenty grm. of carbolic acid; 80 grm. of glycerin.)

Aqua Acidi Carbolici.—Carbolic-acid water (not official). (Glycerite of carbolic acid, ʒ x; water, one pint.) Dose, a teaspoonful to a half ounce.

Unguentum Acidi Carbolici.—Ointment of carbolic acid. (Carbolic acid, 5 grm.; ointment, 95 grm.)

Antagonists and Incompatibles.—Combination with alkalies diminishes, but does not entirely check, the physiological activity of carbolic acid. Saccharate of lime, or lime, is probably the most efficient antagonist from the chemical point of view (Th. Husemann). In cases of poisoning, this substance should be given freely. The mucous membrane should be protected as far as possible by the administration of vegetable demulcents, but not by oils and glycerin, which favor absorption. I am indebted to Dr. A. C. Post, of New York, in a verbal communication, for the important fact that atropine is a physiological antagonist to the systemic symptoms induced by carbolic acid. He was induced to administer atropine in a case of poisoning by carbolic acid, on observing the minutely contracted pupils and the failing circulation. The result was successful. Similar success has attended the same practice in other cases. Experiments on animals have also demonstrated the existence of this antagonism, which may now be regarded as an established fact. The rules for guidance in the administration of atropine are the same as in other cases: a sufficient quantity of the antagonist is administered to maintain dilatation of the pupil and to overcome the depression of the circulation and respiration. Elimination should also be promoted by the free use of diluents.

Synergists.—All of the phenols, the antiseptics, the motor depressants, etc., increase the effects of carbolic acid.

Physiological Actions.—Applied to the integument or to the mucous membrane, carbolic acid produces a burning sensation of short duration, and there is formed a whitish, superficial eschar, which subsequently becomes brownish. The taste of carbolic acid is sweetish, cooling, and then pungent and hot. When swallowed by accident or design, the mucous membrane appears as if brushed over with a strong solution of nitrate of silver, and becomes hard and dry like leather. This appearance is observable about the lips, fauces, the œsophagus, the cardiac and pyloric extremities of the stomach, and the summits of the folds of the mucous membrane in the organ generally. This change in the condition of the membrane is due to the power of carbolic acid to coagulate the albumen of the tissues. Vomiting is not constant, even when toxic doses are swallowed, and the vomited matters smell of the poison. From medicinal doses, a cooling, rather grateful sedative effect is experienced in the stomach. It diffuses into the blood with great facility, from the stomach, from the external integument, and from wounded surfaces. Cases of poisoning have resulted from application to a patch of psoriasis (Toel), to scabies (Hoppe-Seyler, Machin), to the uterine cavity, after the enucleation of a fibroid (Rheinstädter), to abscesses (Köhler, Wallace, White), to the rectum for the relief of ascarides (Pinkham, Michaelis), and to the integument and wounds, in cases of antiseptic surgery. Diffusion takes place with such rapidity, from these various sources, that formidable symptoms arise in a few minutes. The amount necessary to produce distinct effects varies; besides the difference due to age, there are variations in susceptibility. A one-per-cent solution has caused serious symptoms when injected into an abscess and into the rectum. Six drops of the pure acid have caused dangerous symptoms, and a teaspoonful has terminated fatally, but one case is reported in which this amount was recovered from when taken by a child two and a half years old (Dessau). A tablespoonful has caused death in several instances (Cowling, Packer, and others). In Hoppe-Seyler's cases, while the two apprentices were rubbing each other's backs, both were seized suddenly with giddiness, vertigo, and tension of the head, and quickly passed into unconsciousness. These effects are also experienced when the poison is taken into the stomach. The warnings of danger, which may be expected when the remedy is brought in contact with the tissues at any point, are, besides the local irritation, sudden vertigo, contracted pupils, pallor of the face, embarrassed respiration, and feeble circulation. When the dose is a fatal one, unconsciousness quickly supervenes, the breathing becomes ster torous, the surface grows cold, the action of the heart gets more and more feeble, and death finally occurs from failure of respiration. Convulsions occur in animals, but in man this symptom is wanting, or at most fibrillary trembling, and some trismus of the jaws, are present.

The changes in the blood induced by carbolic acid have been much disputed. That it enters the blood as carbolic acid seems positively established, although, having acid properties, it may become a carbolate. The acid has been discovered in the blood by Hoppe-Seyler. That it appropriates oxygen and thus undergoes some change in the blood is highly probable. Husemann maintains that the blood in carbolic-acid poisoning is very much altered in character, becoming dark in color and coagulating with difficulty, but in the reports of various *post-mortem* examinations it is remarked that the blood was coagulated in the heart and great venous trunks. Outside of the body the blood is quickly changed on the addition of carbolic acid, but these changes do not correspond to those which occur within the body. The action of the heart is at first slowed, but toward the end it becomes rapid. The blood-pressure falls considerably below the normal, due, Hoppe-Seyler says, to vaso-motor paresis. The first slowing of the heart is caused by stimulation of the end-organs of the vagus, and is prevented by division of the trunk of the nerve. The subsequent rapid action is due to the removal of the inhibition from paralysis of the vagus. Respiration is at first stimulated and the respiratory acts are more frequent, but they are also more shallow. Division of the pneumogastrics does not entirely prevent this stimulation, although it lessens the effect, whence it is concluded that carbolic acid also stimulates the respiratory center in the medulla (Salkowsky). This conclusion is strengthened by the fact that, if the vagi are previously divided, the administration of carbolic acid will still increase the respiratory acts for a time, showing that the stimulation of respiration must be effected by an action on the end-organs of the vagi in the lungs as well (Salkowsky). Lowering of the temperature has been constantly observed in the experiments on animals, and in the cases of poisoning of man. The surface of the body is cool, and more or less livid. There are several factors concerned, doubtless, in the reduction of temperature. The diminution in the blood-pressure and the arrested oxidation are the chief. The power of carbolic acid to reduce the temperature of fever is also clear, but in this respect it is inferior to salicylic acid (Eisenstein). In cases of poisoning the reduction of temperature reaches several degrees, but in the normal condition in man ordinary medicinal doses have but little effect in this direction.

A more or less minutely contracted pupil is a nearly constant phenomenon in carbolic-acid poisoning. It can hardly be doubtful that this effect is due to paralysis of the radiating fibers, leaving the circular fibers unopposed. Carbolic acid unquestionably acts on the cerebral lobes—on the centers of conscious impressions—and suspends their functions. Vertigo and singing in the ears occur, and then consciousness is lost, the reflexes are suspended, and complete muscular resolution ensues. In warm-blooded animals clonic convulsions are produced, succeeded by paralysis. By direct application, as Bill was the first to demonstrate, carbolic acid suspends the irritability of the sensory nerves. If a tract of the integument be painted over with pure carbolic acid, an incision may be made into the part without the least pain being experienced. The peripheral nerves, sensory and motor, are not affected by the systemic action. The muscles after poisoning respond energetically to the usual forms of stimulation. It follows, then, that the action of the poison is centric and not peripheral (Salkowsky, Lemaire, Rothe).

The elimination of carbolic acid takes place by various channels of excretion, chiefly by the urine. It may be detected by the odor in the breath of poisoned animals (Lemaire). It has been found in the saliva by Hoppe-Seyler, but Bill could not detect it in the perspiration or in the fæces. Hoffmann maintains that carbolic acid undergoes oxidation in the blood, but, as a part of it may be separated unchanged from the urine, this statement is not wholly true. That much of the carbolic acid taken is oxidized before being excreted is proved by the character of a secondary product which appears in the urine. One of the earliest indications of the toxic action of carbolic acid, especially when applied locally, is a dark-greenish, blackish, or smoky hue of the urine. Although this appearance does not actually prove that danger to life is imminent, it is a warning to be heeded. One of the results of the oxidation of carbolic acid is the formation of oxalic acid. The same process takes place in animals, in whom carbolic acid is excreted as oxalic. Doubt has been thrown on the methods by which carbolic acid is detected in the urine of those taking it, through the experiments of Städeler, who has discovered that carbolic acid is present in normal urine. Hoppe-Seyler, however, has proved that, by Städeler's process, carbolic acid is made from the indican of the urine (Hermann). The elimination of carbolic acid taking place through so many channels is readily effected, and probably the whole amount is thrown out in twenty-four hours. When death occurs very quickly in fatal cases of poisoning, the tissues and organs will smell distinctly of the poison (Ogston). Death has occurred in a few minutes—in a great majority of the fatal cases within two hours (Jeffreys), and is rarely postponed to two days. The amount of carbolic acid present will therefore vary.

There are no characteristic *post-mortem* appearances, except the changes wrought at the points of contact with the acid. The mucous membrane of the mouth, fauces, œsophagus, and stomach, where acted on, appears corrugated, tough, and discolored—whitish changing to brownish discoloration, surrounded by a zone of hyperæmia, or capillary hæmorrhages here and there sloughing off. Congestion of the viscera generally, especially of the brain and the meninges, is a constant phenomenon. The lungs are œdematous as well as congested. The heart may be distended with loose clots, and relaxed, or empty and contracted. By some observers changes akin to those of phosphorus-poisoning have been uniformly discovered (Neumann), i. e., acute fatty degeneration of liver, heart, kidneys, and other organs, notably the renal epithelium. Husemann, Salkowsky, and others, deny the reality of these observations, so that further examinations are necessary to determine this point.

Therapy.—*Nausea and vomiting* due to an irritable state of the stomach-nerves are relieved by carbolic acid. Combination with bismuth enhances the effect. ℞ Acidi carbolici, grs. iv; bismuthi subnitrat., ʒ ij; mucil. acaciæ, ℥ j; aquæ menth. pip., ℥ iij. M. Sig.: *A tablespoonful every two, three, or four hours.* Attacks of *cholera morbus* and *cholera infantum* are not unfrequently very promptly arrested by the exhibition of carbolic acid, or the combination of carbolic acid and bismuth. *Eructations of gas*, due to the fermentation of foods, and the vomiting of yeast-like matters, especially when due to the presence of *sarcina*, are often arrested by this remedy. Good results have been obtained by the use of carbolic acid in *Asiatic cholera.* Combination with iodine is said to be more effective (Choleratropfen). ℞ Acidi carbolici, grs. iv; tinct. iodi, gtt. xvj; aquæ menth. pip., ℥ iv. M. Sig.: *A tablespoonful every hour, or oftener.* The same formula has been used successfully in *cholera nostras* and *cholera infantum* (Rothe).

Based on its power to arrest the action of ferments, carbolic acid has been used, with certainly temporary good results, in *diabetes* of hepatic origin (Ebstein, Habershon).

Inhalations of carbolic-acid spray possess a high degree of utility in *chronic nasal catarrh*, *hay-asthma*, *chronic bronchitis*, and *whooping-cough.* A solution in water, to the proportion of one per cent, is a suitable solution for this purpose. It may be combined with the tincture of iodine. The efficacy of these inhalations in hay-asthma and in whooping-cough is probably due to the fact that carbolic acid destroys the minute organisms (cacobacteria, pollen), on the presence of which the morbid action in these maladies depends (Letzerich). The vapor of carbolate of iodine may be inhaled in these diseases. The warmth of the hand suffices to vaporize a mixture of carbolic acid and tincture of iodine.

In *pulmonary phthisis*, when there is much teasing cough, or when expectoration is profuse and foul-smelling, these inhalations are serviceable. In *gangrene of the lung*, carbolic spray and the acid internally are used to destroy the fetor. A one-per-cent solution of carbolic acid and a mixture of carbolic acid and iodine have been injected with asserted advantage into *phthisical cavities* through the parietes of the thorax.

Internally, also, creosote and carbolic acid, especially the former, have been used with conspicuously good results in the treatment of the several forms of *consumption*, except *phthisis florida*. Probably the most useful observations to illustrate this point are those of MM. Bouchard and Gimbert. They used pure creosote from wood, and in the following formula: Pure creosote, 13·5 parts; tincture of gentian, 30 parts; alcohol, 250 parts, and sufficient Malaga wine to make up a thousand parts. Of this solution from two to five tablespoonfuls are taken daily. In other cases the creosote was given in cod-liver oil, which is an excellent vehicle—2 parts of pure creosote to 150 parts of cod-liver oil. The daily quantity varied from six to nine grains, and in rare cases from twelve to fifteen grains. Of ninety-three cases of phthisis treated with this remedy, twenty-five were apparently cured, twenty-nine were improved, eighteen remained no better, and twenty-one died. Creosote thus had a good effect in fifty-four out of ninety-three cases. The evidences of improvement consisted in the diminution of the expectoration, cough, and fever, and increase in the appetite, strength, and weight of body. The diminution of the expectoration, and consequently of the cough, was the first evidence of improvement, although at the beginning of the treatment the cough is apt to be increased for a short time by creosote. If the cough and expectoration are constantly increased, the medicine must be stopped. The danger of hæmoptysis is rather lessened than increased by the creosote treatment. Schnitzler, of Vienna, has employed, recently, the subcutaneous injection of carbolic acid in more than one hundred cases of consumption. He practiced the injections daily, sometimes twice a day, administering each time from one eighth to one fourth of a grain. The result was, in most cases, the fever was reduced, the pulse became slower and stronger, and the night-sweats were diminished. He concludes that these injections are nearly if not quite as effective in relieving hectic as quinine.

Influenced by the germ theory of disease, carbolic acid has been much prescribed in the treatment of *typhoid fever*, *diphtheria*, *scarlet fever*, *erysipelas*, etc. Whether the theory be true or false, there can be no doubt of the good effects of creosote and of carbolic acid in these diseases. Pécholier, of Montpellier, has given creosote in sixty cases of typhoid, set apart for study of the results of the action. Good effects were obtained; the temperature kept down; the delirium and insomnia were much less; the intestinal disturbance declined, and thus the violence of the disease was distinctly lessened. M. Chapelle maintains that it cuts short an attack of typhoid. In the other maladies above named, the evidence of the good effects of carbolic acid is constantly accumulating. Besides the internal administration, local application to the fauces of spray, or suitable solutions, are useful in diphtheria and scarlet fever to remove fetor, and to destroy the germs of contagion which may be lodged there. Recently Rothe has treated a number of cases of typhoid fever, with great success, by a mixed antiseptic and antipyretic method, in which he employs carbolic acid and iodine administered in infusion of digitalis. The author has for several years treated the cases of typhoid and typho-malarial fever so called, which have been in his hands, with a drop each of tincture of iodine and liquefied carbolic acid every two or three hours, with results which were certainly most favorable. As Rothe has observed, this antiseptic treatment lowers the heat, lessens the diarrhœa, improves the mental state, and, indeed, diminishes the severity of the disease remarkably. The value of carbolic acid as a remedy in *malarial fevers* seems now conclusively established. The experiences of Eisenstein in the Vienna General Hospital are especially valuable. He obtained distinct curative effects in twenty-four cases of the *tertian* and in four cases of the *quotidian* type of intermittents. The author has found the combination of carbolic acid and iodine of great value in *chronic malarial infection*, and in the more acute cases after quinine has stopped the paroxysms. As an antipyretic, Eisenstein justly regards carbolic acid as inferior to salicylic. It is probable that resorcin, hydroquinone, and other phenols, will prove more useful than either. Dr. Lecaille has found carbolic acid remarkably efficacious in *yellow fever*, and even after the occurrence of the ominous "coffee-grounds" vomit. He administers it both subcutaneously and by the stomach.

The dose of carbolic acid for internal use ranges from half a grain to two grains, or of the liquefied acid from half a minim to two minims. It may be given in mint-water, which covers the odor somewhat. This quantity may be repeated every hour or two, if necessary, without producing ill effects, if not too long continued. As mentioned above, the quantity given by Bouchard and Gimbert sometimes reached as high as fifteen grains a day. The mixture of bismuth, mucilage, and glycerin, is an excellent vehicle. When iodine and carbolic acid are given together, a colorless carbolate is formed when they are dropped into water.

PARENCHYMATOUS INJECTION OF CARBOLIC ACID.—The deep-seated injection of carbolic acid has been proposed and successfully practiced for the relief of various morbid states. For this purpose a two- to five-per-cent solution is most suitable. A solution stronger than this may excite inflammation in the part and coagulate the blood. It is directed by Hüter that the needle of the hypodermatic syringe be first inserted into the inflamed part, and, if no blood flows out through the needle, it will be known that a vein has not been penetrated. From twenty to thirty minims of the solution are then injected. The injections are made once or twice a day in acute diseases, and on alternate days, or less frequently, in chronic cases. Very remarkable results have been obtained from these injections in *erysipelas* (Hüter, Aufrecht) and in *pleuro-pneumonia* (Kunze).

Dr. Tessier, of the Mauritius, reports that *intermittents* are rapidly cured by the injection of three quarters of a grain of carbolic acid dissolved in twenty minims of water.

The parenchymatous injection of carbolic acid is more especially adapted to the treatment of certain surgical maladies. Hüter has employed this method successfully in *lupus, chancroid, secondary syphilitic abscesses, ulcerations, synovitis* (injected into the affected joint), *fistulæ, enlarged bursæ, hydrocele,* etc. Levis, of Philadelphia, cures *hydrocele* by injecting liquid carbolic acid into the sac after drawing off the fluid. He first inserts the needle of the syringe so that it may be certain the point rests in the cavity. Then the fluid is drawn off, and finally the acid, a drachm or two, is injected through the needle.

Local Application of Carbolic Acid.—*Itching of the skin,* arising from any cause, is allayed by sponging the part with a solution of carbolic acid. ℞ Acid. carbol., ʒ ij; glycerini, ℥ j; aqua rosæ ad ℥ viij. M. Sig.: *Lotion.* This application is especially serviceable in *prurigo* and *prurigo sinalis.* Carbolic acid is an effective application in parasitic skin-diseases—*pityriasis versicolor, tinea tonsurans, tinea circinata, favus, scabies,* etc. ℞ Acid. carbol., ʒ j; glycerini, ℥ j. M. Sig.: *Local application for parasitic skin-diseases.* The internal administration of carbolic acid should be conjoined with its local use in *prurigo, chronic eczema,* and *sycosis parasitica.*

The following is an efficient local application for *chilblains:* ℞ Acid. carbol., ʒ j; tinct. iodi, ʒ ij; acid. tannici, ʒ ij; cerat. simplicis, ℥ iv. M. Sig.: *Ointment.*

Undiluted carbolic acid is used as a mild escharotic to the so-called *mucous patches,* to *condylomata, vegetations,* etc., *lupus, scirrhus, cauliflower-growths,* etc. The author has witnessed results which appear to him to justify the statement that carbolic acid, applied undiluted to the cancerous sore and injected underneath, limits the extension and retards the growth of the disease. In several cases, the disease having recurred at the site of the operation for its removal, the author has apparently arrested the morbid process by injecting beneath and into the new formation daily a syringeful of a five-per-cent solution of carbolic acid. The action in these instances seemed to be local: there were none of the evidences of systemic impression of the poison, and no diffusion of the cancer-germs took place from the point of infection. If further experience confirms these observations, we have in this method a most important contribution to our resources.

Undiluted carbolic acid is an efficient application to *ulcers of the cervix uteri, chronic endo-cervicitis,* and *endo-metritis.* It may be applied undiluted without risk to the mucous membrane of the uterine cavity, on the cotton-wrapped probe, after preliminary dilatation of the canal. There is, probably, no better means of treating uterine catarrh.

Solutions of carbolic acid, of average strength, have the power to check *suppuration*, and to correct the *fetor* of sloughing and ill-conditioned wounds. The methods of Mr. Lister's antiseptic treatment include a much more extended application of carbolic acid. Embracing the fermentation theory of M. Pasteur, Mr. Lister holds to the necessity of excluding germs from contact with wounded surfaces. Operations by the method of Mr. Lister must be performed under and in a spray of carbolic acid (one part to forty). The solution may be pulverized by the ordinary hand-ball atomizer, or better by a Siegle's steam atomizer. All knives, sponges, and ligatures must be "carbolized" before coming into contact with the wounded surface. The antiseptic dressing is thus described by Mr. Lister: "It consists of two pieces of folded gauze and mackintosh (fine cotton cloth with a layer of caoutchouc), an anterior and a posterior one. The wound is covered with several thicknesses of gauze dipped in a solution of carbolic acid (one to forty), and over this is placed the folded gauze and mackintosh, of sufficient size to extend beyond the margins of the wound in all directions." The dressing is confined by turns of a "gauze bandage," and is allowed to remain undisturbed for from two days to a week, "the general rule being that the dressing should be changed on any day on which the discharge is observed to have extended beyond the edge of the folded gauze."

Antiseptic gauze consists of cotton cloth charged with the following: "One part of crystallized carbolic acid, five parts of common resin, and seven parts of solid paraffin"—the paraffin and resin are first melted together, and the acid is then incorporated by stirring. A very complicated process, too elaborate for insertion here, is described by Mr. Lister, for diffusing the above-described mixture equably through the cotton cloth. For lubricating instruments, especially catheters and bougies, he advises a solution of one part of carbolic acid in twenty parts of olive-oil. Carbolized silk sutures are "prepared by immersing a reel of the silk in melted beeswax, mixed with about a tenth part of carbolic acid, and drawing the thread through a dry cloth as it leaves the liquid, to remove superfluous wax."

The following is the University College formula for the preparation of carbolic-acid plaster: "Shellac, 75; carbolic acid, 25. Melt the shellac with 8 of the acid, and then add the remaining 17, and mix thoroughly. The mixture should be spread on linen, and should be coated with a solution of gutta-percha in bisulphide of carbon."

The admirable results in the treatment of wounds obtained by Lister have been fully confirmed by various competent observers (Nussbaum, Thiersch, Volkmann, Bardeleben), and, although objectors have risen to deny the superiority of the method, it has been shown that the ill-success complained of was due to inattention to the various details necessary.

TOXIC SYMPTOMS INDUCED BY CARBOLIC ACID WHEN USED EXTERNALLY.—The extraordinary extent to which carbolic acid is now applied in surgical practice renders it necessary to devote some attention to the symptoms indicating a dangerous degree of absorption. This form of poisoning occurs under two forms: one, sudden, the patient sinking into collapse immediately after the dressings are applied; the other, occurring insidiously, after some weeks of treatment and applications of the antiseptic dressings. Kuster, of Berlin, relates five cases of the first form, in which the patients, after the dressings were applied, sank at once into a condition of collapse like the state of shock from a most formidable surgical operation. Only one of these cases recovered. The diagnosis of this toxic state from surgical shock will be referred to presently. In the other form of poisoning the symptoms appear gradually, and are apt to be attributed to a commencing septicæmia. Loss of appetite, nausea, feverishness, headache, vertigo, and clonic spasms, are first experienced, prostration sets in, and a more or less profoundly comatose state develops. The onset of these symptoms, or the depression which initiates the morbid phenomena in the first form, occurs at a time when more favorable symptoms are properly expected. But the diagnosis is arrived at readily by an examination of the urine. The change in the color and the peculiar odor of the urine observed in carbolic-acid poisoning have been referred to, but the chemical tests are more important. According to Baumann, we have, in Sonnenberg's test, the best means of determining the presence of carbolic acid. This test depends on the fact that any carbolic acid in the urine unites with the sulphates to form the sulphocarbolates, and hence it consists in determining the amount of normal sulphates present. The urine is first acidulated with strong acetic acid, and baric chloride is then added in excess. A copious precipitate, consisting, for the most part, of baric sulphate, is formed, if the urine is healthy; but if it contain carbolic acid, scarcely any precipitate will be thrown down, because of the formation of soluble sulphocarbolates. The researches of Baumann have furnished us with an antidote of a chemical kind, which may be applied if there is time. He has shown that sodic sulphide forms in the body, with carbolic acid, the innocuous sulphocarbolate, and hence a soluble sulphate, as Glauber's salts, will be a proper antidote. As, however, the toxic action of carbolic acid is very speedy, the chemical antidote may not have time. Under these circumstances it will be found, probably, that the physiological antagonist is more speedy and effective. Atropine is apparently a most certain antagonist. It has succeeded in some very unpromising cases, and in my experiments on animals the results have been most favorable to the existence of the antagonism.

Carbolic acid enters into the composition of Morrell's antiseptic fluid, which is used as a disinfectant for general purposes, and for the preservation of bodies. The following is the formula: "Dissolve 13·5 parts of arsenious acid and 6·9 parts of sodic hydrate in 15 to 20 parts of water; add enough carbolic acid until the clear fluid, after stirring, appears turbid (that is, until the liquid is fully saturated with carbolic acid), and dilute with water to make 100 parts."

SULPHOCARBOLATES.—*Sodii Sulphocarbolas.* Sulphocarbolate of sodium.

Potassii Sulphocarbolas; Calcii Sulphocarbolas; Magnesii Sulphocarbolas.

Of these salts, the first-named is the most important, and is the only one official. The first step in the formation of these salts consists in the production of sulphocarbolic acid, obtained by dissolving one part of crystallized carbolic acid in an equal weight of strong sulphuric acid. The next step consists in the formation of sulphocarbolate of barium, from which the other salts are obtained by double decomposition.

Sulphocarbolate of sodium occurs in transparent rhombic prisms, which are permanent in the air, dissolve in about five parts of water, and are also soluble in glycerin and alcohol. Most of the sulphocarbolates have a faint pinkish tint, and are, like the soda-salts, soluble in water, alcohol, and glycerin. The dose for internal administration ranges from ten to thirty grains. Saturated or weaker solutions may be employed topically.

These preparations, devised by Dr. Sansom, were intended to secure the antiseptic and antipyretic action of carbolic acid without any of the caustic and depressing action of the latter. In such septic diseases as *diphtheria*, the *eruptive fevers*, *puerperal fever*, they may be used freely. There seems little ground for the assumption that the carbolic acid is freed from its associates in passing through the organism, for the sulphocarbolates do not have the effects of carbolic acid, and the urine does not have the greenish, blackish, or smoky hue characteristic of the latter remedy. There can be little doubt that the sulphocarbolates are excellent topical applications to the inflamed mucous membrane, wherever accessible. The author has had good results from their use in acute inflammation of the fauces, in *tonsillitis*, in *catarrh of the nares*, in *otorrhœa*, and also in *gonorrhœa*. These salts are useful as deodorant and antiseptic applications to unhealthy wounds and ulcerated surfaces, to *aphthæ* in children, etc. Although the sulphocarbolate of sodium has been added to the new pharmacopœia list, it must be admitted that the sulphocarbolates do not maintain the position to which they were first introduced.

THE SUBCUTANEOUS INJECTION OF CARBOLIC ACID.—Although references have been made to the injection of carbolic acid, it is desirable to indicate some of the more recent applications of this method. For this purpose the author has employed a five-per-cent solution, or one grain to twenty minims of sterilized water. This is injected beneath the affected part in cases of *epithelioma*, of *scirrhus*, of *sarcoma*, and other malignant growths. Besides the extraordinary improvement in the local condition, the diffusion of the infection to neighboring glands, and through the system at large, has in this way seemed to be prevented. The author has reason for believing that by this practice cures can be effected.

Recently the subcutaneous injection of carbolic acid has proved effective in the treatment of *tetanus*. Unquestionably under its use cases of tetanus so treated have got well. While in the case of malignant growths it is preferable to insert the solution deeply into the tissues beneath the malignant growth, in tetanus it may be injected at any convenient point. Thus far no toxic symptoms have been reported from the use of carbolic acid in this manner, but attention should be given to the urine, which would present the earliest indications of toxicity.

Trichlorphenol.—A preparation of much promise and which has yielded good results is that named *trichlorphenol*. It is produced by a combination of chlorinated lime and carbolic acid. A saturated solution of chlorinated lime is treated with a saturated solution of carbolic acid. Trichlorphenate of calcium is a product of the reaction, and remains in solution held by the chloride of calcium, another product. If to this solution some hydrochloric acid is added, the trichlorphenol is precipitated.

A method of extemporaneous preparation for merely topical uses consists in the following: One pound of a solution of carbolic acid, *four per cent* in strength, is mixed with five pounds of solution of chlorinated lime and then filtered. If, for some purposes, this solution is too strong, it can be diluted with *boiling* water to the required strength.

According to Diannin, who first proposed this preparation, it has an antiseptic power twenty-five times greater than carbolic acid, and far exceeds thymol, salicylic acid, and chlorinated lime. It has proved highly effective in *erysipelas*, the solution painted over several times a day (Yurinsky). A *one-per-cent* solution has also been successfully used in the treatment of *ulcers* (Butckik). Other testimony has been published as to its utility in erysipelas, as an injection in *leucorrhœa* and in *dysentery*. On the other hand, Dr. Thomaschewsky has been disappointed in his clinical trials, finding it inferior to iodoform. The truth, as is usual under these circumstances, probably lies in the means.

Creosotum.—*Creosote.*—A mixture of phenols, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech.

An almost colorless, yellowish or pinkish, highly refractive, oily liquid, having a penetrating smoky odor and a burning, caustic taste; usually becoming darker in tint on exposure to light. Specific gravity, not below 1070 at 15° C. (59° Fahr.). Soluble in about 150 parts of water at 15° C. (59° Fahr.), but without forming a perfectly clear solution. With 120 parts of hot water it forms a clear liquid, which on cooling becomes turbid from the separation of minute oily drops. Soluble in all proportions in absolute alcohol, ether, chloroform, benzine, carbon-disulphide, acetic acid, and fixed and volatile oils.

A combination of creosote and tincture of iodine is used successfully by inhalation. The method is simple: To a cup of hot water on a table add a few drops of the mixture, and, as the fumes arise, by means of a paper cone or shield they should be directed to the mouth or nose. Successive deep inspirations should then be made.

Creosote is neutral or only faintly acid to litmus-paper. Dose, ♏ij—♏v.

PREPARATIONS.—Aqua creosoti. Creosote, 10 c. c.; distilled water, 990 c. c.

Guaiacol.—*Methyl-pyrocatechin* is the chemical designation, and it consists for the most part of creosote—from 60 to 90 per cent. It is a colorless, limpid, oily liquid, with a pleasant aromatic odor, having some suggestion of creosote. It is soluble in water in the proportion of 1 to 85. Dose, ♏ij—♏v. Can be administered in pill or capsule, or dissolved in oil (cod-liver oil), or in brandy or whisky.

The value of creosote as a remedy for gastric disturbance—catarrh and other forms in which nausea and vomiting are pronounced symptoms—has long been recognized. Since guaiacol has been introduced into medical practice it has largely taken the place of creosote. It is less disagreeable in taste and odor, and is far less toxic. It is frequently given with bismuth. ℞ Guaiacol, ʒ j; bismuth. subnitrat., vel subcarb., ʒ iv; glycerini, f℥ j; aquæ chloroform, f℥ j; aquæ destil., f℥ ij. M. Sig.: One or two teaspoonfuls in water three times a day. Such a combination is highly useful as a corrective in the ileocolitis of children, in diarrhœa, etc.

Guaiacol has been much given within the last few years in phthisis. The testimony is somewhat conflicting, but on the whole it is evident that in cases not too far advanced it is beneficial. It does not appear to have any toxic influence on the bacillus. It does lessen cough and expectoration, diminishes the fever and sweats, and promotes nutrition. Beginning with one drop, the dose is raised as rapidly as possible to three to six drops and more three times a day. It is a good plan to give it in cod-liver oil. Guaiacol is also applied locally to the walls of the chest in some cases where pain indicates the localization of inflammatory action. It is a valuable local application in *cases of rheumatism and gout*, along the course of the nerve in *sciatica* and other *neuralgiæ*.

Guaiacol is also used as an antiseptic dressing, in solution or ointment, in treatment of affections of the skin, in wounds or injuries where such applications are required, and under the same conditions in which creosote and carbolic acid are now employed.

Benzoyl-Guaiacol—Benzosol—Benzoate of Guaiacol.—These names have been applied to a combination of benzoic acid with guaiacol. Benzosol is the most frequently used of these designations. It contains about 54 per cent of guaiacol, and is a colorless, odorless, and nearly tasteless powder. It is insoluble in water, and is best exhibited in powder. It may also be pleasantly given mixed with chocolate, or be taken in capsules. The dose ranges from 2 to 10 grains.

Creosotal.—By the action of carbon dioxide on creosote, creosotal is produced, and it is therefore the carbonate of creosote, just as the benzoic acid, combining with guaiacol, becomes the benzoate of guaiacol. Creosotal is a viscid, oily liquid, insoluble in water. The dose is from 15 minims to ʒ j.

Phenosalyl.—Under this designation is prepared a mixture of carbolic, salicylic, and benzoic acids by heat, and then dissolved in lactic acid. It is said that to the mixture thus made menthol and eucalyptol dissolved in glycerin are added. Phenosalyl is a clear, sirupy liquid, which dissolves readily in warm water, and to some extent in cold water (seven parts to one hundred parts). It has a pleasing and non-diffusing odor, which does not cling to clothing and instruments. The dose for internal administration ranges from 10 minims to 30 minims. A solution for topical use varies from 1 per cent to 10 per cent.

As respects the germicide power of these three remedies, the most effective is phenosalyl; the most suitable as a substitute for creosote or guaiacol in the treatment of phthisis is benzosol. It is as active as creosote as a remedy, while it is far more manageable. It diminishes cough, lessens expectoration, and stops the hectic fever, while the appetite and general nutrition steadily improve.

Phenosalyl containing several antiseptics should be an effective remedy, but the therapeutic value of such a combination is not measured by the standard of its chief ingredient. It is said to be a more effective germicide than carbolic acid. The most resistant of the pathogenic organisms is the *staphylococcus pyogenes aureus*, and this is destroyed by a one-per-cent solution of phenosalyl. It has proved to be equally effective against the bacillus of cholera, the bacillus of tubercle, the pneumococcus, and other forms of pathogenic bacilli. Although so destructive of organisms, it is not irritating to the skin, and does not corrode instruments. It has been employed chiefly in obstetric practice as an antiseptic topical application, in catarrh of the bladder by irrigation, in gonorrhœa, and in various skin diseases. In gastro-intestinal catarrh, in phthisis, and other wasting diseases, it may be substituted for other remedies of the group.

Salix.—Salix. The bark of *Salix alba* Linné, and of other species of *Salix* (Nat. Ord. *Salicaceæ*).

Salicinum. —Salicin. A neutral principle obtained from several species of *Salix* and *Populus* (Nat. Ord. *Salicaceæ*). Colorless, white, silky, shining crystals, permanent in the air, odorless, having a very bitter taste and a neutral reaction. Soluble in 28 parts of water, and in 30 parts of alcohol at 59° Fahr.; insoluble in ether or chloroform. Dose, ℈j—ʒij. So little soluble, and light in weight and bulky, it were better administered in a wafer, powder, or emulsion.

Actions and Uses.—Salicin promotes appetite and the digestion—properties which it possesses in common with other bitters. It is an antiferment, and has antiseptic powers similar to quinine and salicylic acid. The latter is a derivative of salicin. It is destructive to bacteria and vibrio, and prevents the reaction of amygdalin and emulsin, and of ptyalin on starch. It does not produce very sensible effects even in large doses, and is without toxic activity. It has been used as a substitute for quinine in the cases of disease to the treatment of which the latter is applied, especially in the treatment of *intermittents.* It is, however, much inferior to quinine.

Salicin is an excellent stomachic tonic in *atonic dyspepsia*, and is a serviceable remedy to prevent the fermentations which take place in the foods in cases of *gastro-intestinal catarrh.* In the *chronic diarrhœa* of children, it has been employed successfully. The good results obtained from it in these cases are doubtless due to its antiferment properties and its lack of irritating qualities.

The most important use of salicin thus far proposed is in the treatment of *acute rheumatism.* Its utility has been zealously maintained by Dr. Maclagan, to whom, also, we are indebted for much information in regard to its therapeutical properties. He asserts that the more acute the case the more beneficial the remedy; that the good effects are always experienced within forty-eight hours; that relief of pain and fall of temperature are the earliest effects produced. Maclagan gives from ten to thirty grains every two, three, or four hours, in powder mixed with water. "Fifteen grains every three hours is a medium dose."

Much confirmatory evidence has been published; but, on the whole, salicin is generally regarded as inferior to salicylic acid. There are conditions of the system, however, in which salicin should be preferred to any of its congeners. In those cases characterized by weak heart, whether from adherent pericardium, myocarditis, fatty degeneration, or other causes, salicylic acid may be dangerous. Again, when the vaso-motor system is depressed, salicin is far safer. As the curative results obtained from salicin are but little inferior to those from salicylic acid, whenever the latter is contraindicated the former may be confidently relied on, if efficiently administered.

Authorities referred to:

Husemann, Drs. Aug. und Theod. *Pflanzenstoffe*, p. 959, *et seq.*

Maclagan, Dr. T. *The Treatment of Acute Rheumatism by Salicin.* *The Lancet*, March, 1876.

Acidum Salicylicum.—Salicylic acid. *Acide salicylique*, Fr.; *Salicylsäure*, Ger. An organic acid, existing naturally in combination in various plants, but most largely prepared synthetically from carbolic acid.

Properties.—Salicylic acid crystallizes in needle-shaped crystals, which are soluble in alcohol and ether, and in hot but not in cold water. It is without smell, and its taste is slight and not disagreeable. The solubility of salicylic acid in cold water is increased by the presence of neutral salts. Three parts of phosphate of sodium will render one part of the acid easily soluble in fifty parts of water. Borate of sodium is still more efficient in promoting the solubility of the acid, and, as boracic acid has properties corresponding to salicylic, the borate should be preferred for this purpose. It has been shown that ten parts of salicylic acid can be dissolved in one hundred parts of water by the addition of eight parts of borax (Bose). The borax should be first dissolved by the aid of heat, and the salicylic acid should be added gradually to the hot solution of borax. On cooling, filtration is necessary to separate a small quantity of undissolved residue.

The dose of salicylic acid for internal administration ranges from ten grains to one drachm.

Sodii Salicylas.—Sodium salicylate. Dose, grs. xv—ʒ j. In wafer or powder it may be given rapidly until the requisite quantity has been swallowed. Salicylate of soda may be prepared extemporaneously by the addition of salicylic acid to a solution of bicarbonate of sodium. If the alkali is in excess, the resulting solution is brownish or purplish in color, and has a strong odor of wintergreen. This is not repulsive to most patients.

The following is a suitable formula: ℞ Acidi salicylici, ʒ ij; sodii bicarb., ʒ j; aquæ, ℥ ij. M. Sig.: A teaspoonful every two, three, or four hours.

Antagonists and Incompatibles.—The mineral acids, the metallic salts, and the preparations of iron in general, are chemically incompatible. From the physiological standpoint, salicylic acid and the salicylate of soda are antagonized by the arterial and cerebral stimulants.

Synergists.—The effects of salicylic acid are increased in all directions by the members of the phenol group, by the arterial depressants, and by the anæsthetics and cerebral sedatives.

Physiological Actions.—In small doses, salicylic acid may stimulate digestion, but in considerable quantity, especially if frequently repeated, it causes uneasiness at the epigastrium, nausea, and vomiting. This inability of the stomach to dispose of the large doses of salicin, salicylic acid, and salicylate of soda, required in the treatment of certain diseases, is an obstacle to their use. They are diffusible and readily enter the blood. It is in a high degree probable that salicylic acid combines with an alkaline base and enters the blood as a salicylate—as a salicylate of sodium, according to Salkowsky. Binz holds that the free carbonic acid present in the blood must effect the separation of salicylic acid from its combinations, and hence that salicylate of soda must act as salicylic acid. It is well known, of course, that salicylate of soda does not possess the antiseptic property of salicylic acid, and, as both act similarly after their medicinal administration, it seems highly probable that the decomposition just mentioned does actually take place. An observation of Köhler seems to support the theory of Binz. Köhler found that, while ordinary blood containing salicylic acid did not yield it up to ether, the blood of asphyxia, which contains an exceptional quantity of carbonic acid, did yield up its contained salicylic acid to ether. The blood in the vessels unquestionably contains more carbonic acid than that which has been exposed to the air. Salicin, as Senator first demonstrated, under the action of ferments, splits up into saligerine and glucose, and saligerine is readily oxidized into salicylic acid. This process is supposed to occur in the body, and hence the comparative slowness of action of salicin and similarity in its effects to salicylic acid. Spencer, examining the blood of a person taking salicin, only got evidence of the presence of the glucoside but not of the salicylic acid, and in the urine of the same subject found but a small part of the acid which ought to have appeared, whence he concludes that the conversion of salicin into salicylic and salicyluric acids, according to Senator, is but partially accomplished in the organism. These observations adequately explain the superior activity of salicylic acid as compared with salicin.

In health, ordinary doses of salicylic acid and salicylate of sodium have but little effect on the circulation. In the carefully conducted experiments of Ringer and Morshead, made on normal subjects, considerable doses of the acid increased the pulse-rate from ten to twenty beats, but more or less feverishness was produced by the irritant action on the gastro-intestinal mucous membrane. The manometric studies of Köhler demonstrated that this agent lowers the blood-pressure, and this result occurred after division of the vagi, the depressors, and the spinal cord, whence it must be concluded that it accomplishes this result by a direct action on the heart and vaso-motor ganglia.

More recent observations by Oltramare show that when salicylic acid is thrown into the veins the first effect is to increase the energy of the systolic contractions, the number of pulsations, and the blood-pressure. These effects, he finds, are due to a direct stimulation of the heart and of the motor centers. Under the influence of increasing doses, the vessels dilate, the blood-pressure falls, and finally the heart is arrested. There is, therefore, a general agreement as to the increase of the action, lowering of the blood-pressure, etc., as studied in animals, and observed on man by Ringer and Morshead. Professor Sée, however, fails to discover any effect by salicylic acid on the heart or blood-pressure, but, as he administered the remedy by the stomach, it is probable that he did not secure admission to the blood of a sufficient amount.

The numerous observations made on the effect of salicylic acid and salicylates on the heat-function are in close accord. In health it is found that, unless toxic doses are taken, the temperature is but slightly or not at all affected. Riess, one of the first to make observations on this point, noted a constant reduction of the normal temperature; but Sée, Ringer, Fürbringer, and others, agree that in health this agent does not affect the temperature. Riess's conclusions were based on more than four hundred observations of the internal use of salicylic acid, and in twenty-three cases he ascertained a reduction of 1·6° Fahr., produced by five grammes (nearly eighty grains). If fever is present, whether produced artificially by the injection of septic materials, or arising spontaneously, salicylic acid very uniformly effects a considerable reduction. The result, however, is not always the same. That salicylic acid has a decided antipyretic action is denied by Zimmermann, Wolffberg, and some others; but the weight of testimony is overwhelmingly the other way. It is certain that the degree of antipyretic effect varies in different forms of fever (Bartels, Senator, Nathan, and others), and also according to the individual susceptibility to its action. The phenomena attending the reduction of temperature are worthy of consideration. At the onset of the action, in ten to fifteen minutes after the dose is swallowed, some increase in the heart's action, a feeling of warmth through the system, and flushing of the face with suffusion of the eyes are experienced, then the perspiration begins, appearing first on the face, then on the chest, abdomen, and extremities, and presently becomes profuse. Coincidently with the sweat, the decline in temperature begins, but it continues after the sweating. There is no ratio between the amount of sweating and the reduction of fever-heat, for with much sweating there may be but slight diminution in the temperature, and with little sweating a marked decline. In febrile cases the decline of temperature varies from 1° to 6° Fahr. (Riess, Nathan, Bartels, Ewald, and others). The quantity of salicylic acid necessary to effect any considerable reduction of temperature ranges from one to two drachms. The effect is maintained from five to twenty hours, when a repetition of the dose usually becomes necessary. With the first effect of the agent on the heart, the pulse rises, but, as the sweating progresses, more or less slowing of the heart-beat occurs. There are differences of opinion, however, on this point. Thus, Ewald, Riess, Goltdammer, and a few others, hold that the pulse is little if at all affected ; but the usual expression is that, after a preliminary rise, there ensues with the perspiration and lowering of the temperature a marked decline in the pulse-rate (Buss, Stargard, Nathan, Moeli, etc.).

With the first impression of this agent on the respiratory center, the number of respirations is increased, but, with the decline of temperature and of the pulse, they are lessened. The excretion of carbonic acid, Livon shows, is the greater, the larger the dose of salicylic acid, estimated during the period of increased action of the lungs. Under the influence of large doses, accumulation of the acid takes place in the cerebro-spinal fluid, causing an excitation of the roots of the pneumogastric nerve, but the excitation is succeeded by the depression which terminates in arrest of the respiratory function.

As the effects of salicylic acid or salicylate of sodium develop, more or less headache, with a feeling of distention and frontal oppression, is experienced. Buzzing in the ears, dullness of hearing, and even deafness, are usual symptoms when the doses are large. Vision is also affected, the sight becoming dim, or strabismus or ptosis occurs. In one case sudden and complete amaurosis came on (Gatti) after the administration of one hundred and twenty-five grains of salicylate of soda ; the pupils were widely dilated, the sclerotic and cornea acquired extreme sensibility, but the retina was unchanged, and the vision fortunately was restored after ten hours without impairment. In other cases, subacute delirium, or delirium with refusal of food, and various delusions (Daly) have occurred while patients were taking considerable doses. Ordinarily, however, the cerebral effects of salicylic acid are not unlike those of quinine. The state of the intracranial circulation which it induces has not been studied. According to Blanchier and Rochefontaine, salicylate of soda depresses the functions of the central nervous system, but the irritability of both sensory and motor nerves and the contractility of muscle remain unimpaired.

Animals to whom salicylate of sodium is administered daily for some time, emaciate rapidly (Chirone and Petrucci). The toxic dose for the dog, ass, and horse, according to Oltramare, is one gramme per kilogramme of the body-weight. Death is due to paralysis of the heart, and not from asphyxia, as has been heretofore supposed (Oltramare). After death the abdominal viscera are intensely congested, unless the medulla be divided, when a marked degree of anæmia succeeds to the hyperæmia. It is this fact chiefly which induces Oltramare to maintain that salicylate of sodium acts on the vaso-motor center in the medulla.

On man as well as on animals sometimes salicylic acid produces serious symptoms. The intoxication, with delirium and delusions which it causes in certain subjects, especially those suffering from acute rheumatism, has been referred to. In drunkards it is especially apt to act unfavorably, bringing on in them violent delirium. In rare instances salicylic acid and the salicylates have induced a condition of collapse, with restlessness, delirium, great dyspnœa, feeble pulse, and involuntary evacuations. The vaso-motor paresis, which is a result of large doses in feeble subjects, may be accompanied by great relaxation of the skin, the rapid formation of bed-sores, etc. Dr. Tuckwell, of the Radcliffe Infirmary, Oxford, gives the following symptoms as occurring in two cases under his observation: "Loud, deep, and sighing respiration; a strange restlessness, gradually increasing to delirium, and not unlike that of delirium tremens, with involuntary evacuation of urine and fæces in the worst of the two cases; a slow and laboring pulse; an olive-green color of the urine." No fatal case, distinctly due to these preparations, has been reported, but many have occurred in which very dangerous symptoms arose; but, fortunately, all disappeared on stopping the administration of the remedy. The existence of albuminuria is an important factor in the causation of bad results (Huber).

The rate of diffusion of salicylic acid has been closely studied by Blanchier and Rochefontaine, with the following results: When injected into the veins of a dog, salicylate of soda appeared in the saliva in four to five minutes; in the urine, eight to ten minutes; and in the bile and pancreatic secretion, in fifteen to twenty minutes. When taken into the stomach, it appeared in the saliva in twenty minutes, and in the urine in forty-five minutes. In man salicylic acid is excreted chiefly, almost wholly, by the kidneys, and appears in the urine in twenty minutes after it is taken into the stomach. It is excreted as salicyluric acid, which may be seen as a deposit at the bottom of the vessel, "of a white, feathery consistence." The urine presents a more or less deep greenish tint. The presence of the acid is readily ascertained by the solution of chloride-of-iron test. To the urine suspected to contain salicylic acid, add slowly, drop by drop, the chloride-of-iron solution; phosphate of iron is first formed, which is whitish in color, but presently, if salicylic acid be present in a free state, a violet color is developed. The urine, during a course of the acid or of the salicylates, frequently contains albumen, due, doubtless, to the irritation of the kidneys as elimination is going on. The facts do not yet warrant any conclusion in regard to the damage which may be permanently inflicted on the kidneys by the prolonged administration of this agent. The influence over the urinary excretion has been examined by Bouchard. There is reason for believing that the urinary water is not augmented, the extractives are somewhat increased, and the phosphates and coloring-matter are unchanged. Prof. Sée finds that the excretion of uric acid in gouty cases is promoted. It is maintained by others that the amount of urea present in the urine is greater than normal. Livon and J. Bernard have ascertained that salicylic acid, after being thrown into the stomach or into a vein, appears within an hour or two in the saliva, milk, pancreatic secretion, bile, as well as urine, and it was always found in the cerebro spinal fluid. They conclude that it acts locally at these points of contact with the structure of organs. Hence, it appears highly probable that the local stimulation increases the product of those glands through which the acid or its salt passes, but not in the urine, if Bouchard's observations can be relied upon. Albuminuria, according to Gubler, is produced by it in some cases, and temporary impotence has been observed in others.

THERAPY.—The applications of salicylic acid in the treatment of disease are based on the results of the physiological examination. In the diseases of the stomach characterized by fermentative changes in the food, as in *catarrh*, *dilatation* of the organ, etc., salicylic acid is an effective remedy. The author has seen admirable results from its use in *gastralgia*, even when distinctly periodical. In the vomiting of a pasty, fermenting mass of ingesta, whether or not accompanied by the organism, *sarcina*, or other germs of fermentation, good results are derived from this remedy. In these stomachal disorders, the best effects are had from ordinary doses (five to ten grains), given in a wafer, either in anticipation of the attack—as of gastralgia appearing at a fixed hour—or during the process of fermentation in the stomach contents. As a portion of the remedy taken passes into the fæces, it is probable that salicylic acid is just as effective in the corresponding troubles in the intestines. Ilgin reports the removal of *tænia solium* in six cases by the administration of salicylic acid, in eight-grain doses every hour until five doses were taken—preceding and following the acid with a dose of castor-oil. It has been employed successfully in the removal of *ascarides*, by local application and by internal administration. An enema of water should precede the salicylic-acid solution, which may be composed of borax and salicylic acid with some glycerin. ℞ Acid. salicylic., ʒ ss; sodii biborat., ʒ ss; aquæ, Oj. M. Sig.: Warm, and administer the whole amount at one time. For a young child, this quantity should be reduced one half, or more.

When the heart is weakened from any cause, salicylic acid and salicylate of soda must be exhibited with caution. The experience thus far accumulated warrants the assertion that the dose of fifteen grains of the former and twenty of the latter should rarely be exceeded, if frequent repetition of the dose is practiced. From Riess, who regards salicylate of soda as a specific in *typhoid fever*, to Filatow, who holds that it is worse than useless, there are various shades of opinion, with the weight of authority decidedly in favor of the view that it is a remedy of real value. Since Riess, no one has claimed in this remedy a specific for typhoid, but it is generally admitted that it renders the course of the disease milder by keeping the temperature within safe limits (Tomkins, Hallopeau, Butt, Immermann, Senator, etc.). Weiss concludes, after an experience of ninety-six cases of typhoid in children, treated with salicylate of soda, that it is a powerful antipyretic in the typhoid of children, and that, while it does not shorten the course of the disease, it renders it much milder. He finds that the results are better, when the typhoid of children is treated by salicylate of soda, than have hitherto been obtained from quinine and cold baths. A still more recent English experience is to the same purport as the German. Dr. Tomkins finds that in the salicylates we have the means of reducing fever-heat, more certain and more agreeable than by the cold bath. In the *eruptive fevers*, the same principles obtain as in typhoid. Salicylate of soda is preferable to salicylic acid, because it is less irritating, safer, and equally effective as an antipyretic. The object of its administration is to reduce the heat, which is the most important source of danger. The amount required to accomplish this object is now definitely known. Twenty grains of the soda salt may be given every two hours, until the temperature is reduced to the proper point, at which it may be held by ten-grain doses at the same interval, unless the occurrence of an exacerbation requires the exhibition of a larger quantity. In the case of children, the daily quantity ranges from half a drachm to a drachm. Probably the best mode of administering the salt is in the form of wafer, but when these can not be obtained, a solution may be readily prepared, or the salt may be constructed extemporaneously by adding the acid to a solution of sodic carbonate as follows: ℞ Acid. salicylic., ℈iv; sodii bicarbonat., ʒj; aquæ, ℥jss; syrup. simpl., ℥ss. M. A tablespoonful contains about twenty grains salicylate of soda. It should be borne in mind that this remedy is not safe if the heart is very weak, or if albuminuria is present.

In *relapsing fever*, according to Riess, salicylic acid accomplishes something more than the mere reduction of temperature. Although it does not prevent the usual relapse, even when administered in large doses during the interval, it lessens the severity and duration of the relapse. It does not destroy the *spirilla* in the blood, nor indeed lessen their activity (Riess), and hence can not be a curative agent in this disease. In *pyæmia*, *septicæmia*, *puerperal fever*, *diphtheria*, etc., salicylate of sodium is used under the same rules as in typhoid. The indication for its use is high fever, and the good accomplished by it is determined by the degree in which the temperature is reduced. The antiseptic action is quite secondary to the antipyretic. In *mala* *rial fevers* it was supposed by Senator and others, in the enthusiasm attending the introduction of the remedy, that salicylic acid would prove equal to quinine. If administered in a full dose just before the advent of a paroxysm, it will prevent it, but it does not possess the curative powers of quinine over the effects of the malarial poison, and hence will not prevent relapses. By using salicylate of sodium to abort an impending paroxysm, and quinine to prevent relapses, the curative result will be attained with the least pecuniary expenditure. In the mildest cases of intermittents, salicylate of sodium may be depended on alone, but, to succeed, it must be administered before the expected paroxysm.

Out of the enormous mass of published experience in regard to the value of salicylic acid in *acute rheumatism*, it is difficult to select. From the first trials of Buss, followed by Stricker and Traube, there has been an almost unanimous expression of opinion by the German physicians in regard to the value of this agent in rheumatism. At first it was supposed that the disease could be invariably cut short in forty-eight hours to three days, but larger observation has qualified these opinions. By way of illustration of the measure of success now attained in Germany with salicylic acid in rheumatism, we may take the recently published statistics of Diesterweg. Of one hundred cases treated with this remedy, the disease was cut short in thirty-six or twenty-four hours; in eighty-five, within the period of forty-eight hours; in ninety-eight, within seventy-two hours; in one the disease was prolonged to eighty-four hours; and in one the remedy had no effect on the disease. It is not intended to convey the impression that the cases got well in so short a time, only that the fever and joint-swelling and pain subsided, and convalescence was established. Relapses occurred in eleven cases, and cardiac complications in five.

In France the treatment of acute rheumatism by salicylic acid was taken up by Jaccoud, Lepine, Gueneau de Mussy, and others, but especially by Prof. Sée, who has devoted to it several important lectures. As a result of Sée's observation, he concludes that salicylic acid has a marked and peculiar benefit in acute rheumatism; that the pains invariably cease in from twelve to eighteen hours; that the articular swelling disappears at the end of three days, and that the fever subsides with the pains. If the fever persists, other joints will become affected. Out of fifty-two cases treated by Prof. Sée, fifty-one recovered in from two to three days. These results are quite equal to the German. Sée makes an important observation in regard to the rapidity with which salicylic acid and salicylate of sodium are eliminated, and the necessity, therefore, of continuing the remedy for some time after all the joint-troubles have ceased, to prevent relapses. Prof. Gubler does not share the general enthusiasm as to the value of this agent in rheumatism. He emphasizes the uncertainty and the dangers attending its use, and maintains that it has no antipyretic effects.

In England salicylic acid and salicylate of sodium have been used with a large measure of success, but the rheumatism of England, as of this country, does not yield with the promptness characteristic of the Continental disease. The general results of the treatment, as conducted in England by Broadbent, Carafy, Spencer, Boggs, Greenhow, and many others, is very much as expressed by the last-named in his important communication to the Clinical Society. The temperature speedily falls, sometimes within a few hours and almost always in two or three days, the pulse declines at the same time, the pains subside correspondingly, and the joint-swelling diminishes and disappears within three or four days. Greenhow points out that such a result is not a cure even in the most favorable cases; that the remedy acts very injuriously on the heart and causes a deep anæmia, and that, therefore, the duration of the disease, from beginning to the termination, is not actually shortened. Dr. Maclagan (also Charteris) strongly urges the substitution of salicin, on the ground that it is equally effective with salicylic acid and much less dangerous; but it is difficult to appreciate this argument, since salicin is converted into salicylic acid in its passage through the system.

In this country, the experience of the Maine physicians, and of the medical staff of the Massachusetts General Hospital, has been published, and all concede that it has good effects. As regards the experience at the Massachusetts General Hospital, the facts are as follows: In eight cases out of seventeen treated with salicylic acid, the duration of the longest case was twenty-six days, and the shortest five days, the improvement being very marked from the beginning of treatment. Of three patients who took salicylate of soda only, the duration of the disease was less than twelve days in each case, the shortest being two days. In the remaining nine cases the duration was six weeks or more.

In summing up the testimony, it is clear that salicylate of soda is a most valuable remedy in acute rheumatism, but various unpleasant, even dangerous symptoms arise in some cases. Violent headache, vertigo, and *tinnitus aurium*, are common; wild delirium is an occasional symptom; weakness of the heart, obscuration of the first sound, and profound anæmia, are especially noted by Greenhow; very great gastro-intestinal disturbance is now and then produced. Empis narrates a fatal case of acute rheumatism which was treated by salicylic acid. Great depression of the powers of life, in rare instances approaching collapse, has been observed. Sufficient is now known of the danger attending the salicylic medication of acute rheumatism, to justify the author in urging circumspection on the attention of his readers. The robust and vigorous rheumatics are proper subjects for this treatment, whereas, in the pale, feeble, and cachectic, especially those with weak hearts, this treatment must be pursued cautiously, or not undertaken at all. Relapses are frequent, probably because of the very rapid elimination of the remedy, as suggested by Prof. Sée, and hence its administration must be continued for some time after all of the local and systemic symptoms have subsided.

In *gout*, *chronic rheumatism*, *myalgia*, and *lumbago*, salicylate of sodium often acts most serviceably. It is more effective the more acute the malady, as a rule, but it sometimes does great good in the most chronic cases. Abbott reports the cure of *sciatica*, and Brun of rheumatismal *irido-choroiditis*, by its use. The author has succeeded in some instances very promptly in the cure of sciatica by the salicylate of soda—the formula used being that for the extemporaneous solution. The cases in which this remedy has proved most efficacious, were those of functional disturbance in the nerve, the muscles being in their normal condition, and the pain having nocturnal exacerbations.

It is a very interesting fact, first distinctly stated by Dr. Pye Smith, of Guy's Hospital, London, that, during the administration of salicylic acid and the salicylates, the urine exhibits the reaction for sugar on the application of Trommer's test. This has been observed in rheumatism and in other diseases treated with this agent. The urine is a little increased in amount, but its specific gravity is not changed. The reduction of the copper is effected by the acid or by the glycogen, which is one of the products of the decomposition of salicylic acid. Müller, the assistant of Eckstein in the clinic at Kiel, has published some important observations on the use of salicylate of soda in the treatment of *diabetes*. It appears that full doses of the salt cause the sugar to disappear entirely, but this is not a permanent result, for, after a time, the sugar returns. A very great tolerance to the remedy exists in this disease, and large doses may be taken with impunity. Bouchardat, in commenting on these observations, states that he has not had good results from this treatment. Since, however, the remedy is well tolerated, and during its exhibition in considerable doses the sugar disappears, it may be used with advantage at critical times to stop the waste.

Salicylate of sodium has feeble antiseptic properties, and hence salicylic acid, which is even superior to carbolic acid in its power to destroy minute organisms and to prevent change in putrescible materials, should be preferred for all topical applications. Being free from odor, and more active than carbolic acid, it should be used instead of carbolic acid for most purposes. For all toilet purposes, it is decidedly preferable. It is an excellent addition to the ordinary powder *dentifrices*, and its solution with borax is an efficient deodorant in *fetid perspiration*. This disagreeable affection, as it attacks the feet, may be relieved by dusting the feet thoroughly with powdered salicylic acid before putting on the stockings. It is useful, also, to fill the interstices of the stockings with the powder. Extraordinary success has been achieved by the local application of this remedy in *eczema of the head and face.* Those cases characterized by much weeping seem to be best adapted to the cure by salicylic acid, but *eczema rubrum* and *eczema impetiginodes,* that resisted other approved means, have yielded to the application of this agent (Wagner, Will). It is generally conceded that, as a local application to *syphilitic ulcers,* salicylic acid is inferior to carbolic acid.

The most important of the topical uses of salicylic acid are in the antiseptic treatment of wounds and injuries. When it was shown that this agent had a power to destroy the activity of ferment and disease-germs equal to that of carbolic acid, while it is free from the irritating quality and disagreeable odor of the latter, Thiersch, who is a strong advocate for Lister's antiseptic method, resorted to the use of salicylic-acid solutions. Further experience has, however, rather proved the superiority of carbolic acid in respect to the germicide and antiseptic properties for which these remedies are now so largely employed.

To *cancer, gangrenous and sloughing wounds,* pure salicylic acid may be applied in powder. To prevent the contact and multiplication of atmospheric germs, operative procedures may be conducted in salicylic spray, the sponges and dressings may be saturated with salicylic solutions, and the wound irrigated by the same. In order to carry out all the details of the antiseptic method, salicylic acid is substituted for carbolic in the forms and combinations of dressings employed by Lister. Wounds are covered with cotton-wool, impregnated with an alcoholic solution of the acid in the proportion of 3 and 10 per cent. As cold water takes up only 1 part to 300, which, however, is strong enough to destroy bacteria, etc., the addition of borax is generally necessary to obtain a solution of sufficient strength for the antiseptic applications. A salicylic-acid plaster may be prepared as follows: Salicylic acid, ʒ ss — ʒ j; white wax, ʒ j; paraffin, ʒ ij; almond-oil, ʒ ij. The ingredients are melted, and rubbed up together in a heated mortar (Will), and spread on muslin. An ointment more readily melted by the heat of the body is the following: sperm-oil, ʒ jss; cacao-butter, ʒ vss; salicylic acid, ʒ ss — ʒ j. This should be melted together, thoroughly incorporated, and spread on lint (Will). An ointment for the same purposes may be prepared in a simpler way by the addition of salicylic acid to simple cerate. A solution of salicylic acid in olive-oil, in the proportion of one drachm to eight ounces, is an efficient local application for *burns.*

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Resorcinum.—*Resorcin.* A diatomic phenol.

HISTORY.—Resorcin is a chemical compound, discovered by Hlasiwetz and Barth, and was obtained from certain resins by the action of fusing alkalies. They assigned to the new compound the name *resorcin*, partly because it is derived from a *resin*, and partly because it has some similarity to *orcin*, a peculiar substance obtained from archil. Subsequently resorcin was constructed synthetically by Körner, and at the present time it is obtained in various ways, the product being both pure and cheap (Andeer).

PROPERTIES.—Resorcin occurs in tabular prismatic crystals, rather shining and lustrous, somewhat sweetish to the taste, with a little after-pungency. When struck or rubbed in the dark, it appears phosphorescent. In odor it is somewhat like phenol, but not nearly so pronounced. It is soluble at 59° Fahr. (15° C.) in 0·6 part of water, and in 0·5 part of alcohol, and in ether and glycerin. It is dissolved by all liquids except chloroform and carbon sulphide. Aqueous solutions exposed to the air and light assume a more or less brownish tint, but without any apparent change in quality. Albuminous liquids treated with a concentrated solution of resorcin become turbid by the formation of an albuminate of resorcin. Various secondary products are obtained from it by the action of chlorine, iodine, bromine, nitric and nitrous acids, etc. In the process by which resorcin is produced, are also *hydroquinone* and *pyrocatechin*. The best vehicles, according to Andeer, are alcohol, glycerin, and sirup of orange. The dose for usual purposes ranges from five to fifteen grains. For a decided antipyretic effect a drachm may be given, but this amount could not be frequently repeated. Five grains may be given every two hours in an ordinary case.

ANTAGONISTS.—From the physiological standpoint, resorcin is antagonized by the cerebral excitants, by the agents which raise the arterial tension, and by the cardiac and respiratory stimulants—by atropine especially. The local caustic action, and the depression in the circulation and respiration, are the effects requiring attention in cases of poisoning by this substance. It is less actively toxic than carbolic acid.

SYNERGISTS.—Its effects are promoted by quinine, salicylic acid, carbolic acid, etc.

PHYSIOLOGICAL ACTIONS.—Resorcin does not irritate, nor is it absorbed by the unbroken integument. The solution injected into the subcutaneous tissues produces but little irritation, and never inflammation and abscess. Applied to the moistened mucous membrane, it causes vesication, and a white blister forms, like that from carbolic acid. It has decided anti-ferment properties, arrests decomposition in animal tissues, deodorizes, and is destructive of the minute organisms on the presence of which putrefactive decomposition is dependent. A one-per-cent solution will prevent the decomposition of urine when exposed to the air for months (Andeer). Applied to unhealthy wounds, it arrests the decomposition, destroys the fetor, and promotes healthy cicatrization (Dujardin-Beaumetz).

The action of lethal doses is necessarily to be studied on animals. Murrell has, it is true, given a good account of the symptoms produced by an overdose, but the details can be obtained only by experiments on animals. Soon after the administration of a full dose—thirty centigrammes (about five grains) of resorcin per kilogramme (about thirty-five ounces) weight of the animal experimented on—trembling begins, due to fibrillary contractions of the muscles, and this passes into general clonic convulsions of an epileptiform type. These convulsions regularly increase in severity, and, reaching their maximum in a few minutes, as regularly decline, the whole duration of this phase of the action being about two hours, sometimes longer. The spinal cord is doubtless the seat of the action, since the irritability of the peripheral nerves and muscles is diminished only, and not entirely destroyed. The general sensibility is preserved, whence it must be concluded that the action of resorcin is on the motor elements (Callias). The blood seems not to be altered in respect to its composition or properties ; it presents a normal appearance, coagulates in the usual manner, and the venous blood, exposed to the air, assumes the proper red hue.

The lethal dose, according to weight, is ninety centigrammes per one kilogramme. The phenomena observed when such a dose is administered are the same as those above sketched, except that sensibility is impaired as well as motility.

Resorcin, through the action on the nervous system, affects the respiration and circulation when the dose is large. At first the respiration is greatly increased in frequency, becomes convulsive and jerking, and afterward shallow and weak but rapid. The action of the heart also becomes rapid, the pulse weak and somewhat irregular, but the respiration ceases before the action of the heart. The temperature rises, and just before death attains to 103° to 105° Fahr. This increase of the body-heat is doubtless correctly attributed to the extreme muscular action (Dujardin-Beaumetz), and not to irritation of a hypothetical heat-center. Resorcin, which acts in many respects so like quinine, however, differs from this agent remarkably in respect to the lethal effects.

When a considerable dose of resorcin (thirty to sixty grains) is administered to a person in a fever, in a few minutes a sense of heat is felt about the epigastrium, and spreads thence over the system ; the face flushes and grows hot, the eyes glisten, the breathing and pulse are accelerated, and dizziness, with ringing in the ears, and frontal headache, are experienced. A good deal of discomfort, oppression of the chest, and a sense of distention of the head, are usually produced, but these sensations subside in from ten to fifteen minutes, the skin then grows moist, and in a few minutes more a profuse perspiration is pouring out on the surface of the body. The pulse then falls, coolness succeeds to heat, languor to tension, and the temperature of the body declines several degrees. If the feverish state has no special features, the lessening of the pulse and reduction of temperature to the normal occurs in about an hour. The pulse may be slowed one third, and the reduction of temperature be as much as three or more degrees of Centigrade or five degrees Fahr. (Lichtheim). The reduction of temperature in fever is of comparatively brief duration, lasting from two to four hours. When the rise of temperature begins again, a sense of chilliness is experienced, which may even take the form of a distinct rigor. Lichtheim observed great differences in the power of resorcin in different fevers. The less the tendency to spontaneous remissions, the less the antipyretic effect. The fever accompanying pneumonia and erysipelas was less amenable to the action of resorcin than was typhoid fever, but no form of fever entirely resists its action. In the normal, the action on animals and on man corresponds closely. The correspondence also exists in respect to the action in pathological states, as above stated. To the information thus obtained may be added the experiences on healthy men, as furnished us by Andeer, by Baumann and Preusse, Fauber, and others. In small doses, the circulation, respiration, and temperature are but little affected. Andeer, from a dose of ten grammes (one hundred and fifty-five grains), suffered from dizziness, confused vision, deafness, considerable salivation ; presently extreme vertigo and loss of consciousness occurred, and then general clonic convulsions and tetanic rigidity of the muscles of the neck came on. There was no decline of temperature. All of the effects subsided in five hours. The preliminary stage of excitement produced by resorcin is often accompanied with excitement and delirium. In one case a deep stupor ; in others, muscular trembling and incoherence of speech were observed.

The elimination of resorcin takes place almost entirely by the urine, and it is effected quite rapidly, for the greater part absorbed is excreted in an hour. The state of the kidneys, therefore, must influence the rate of elimination, and correspondingly the duration of the physiological or therapeutical actions. The tests for ascertaining the presence of resorcin are not sensitive for small quantities. The most easily applied is the solution of perchloride of iron, which causes, when resorcin is present, a deep violet, almost black, color.

THERAPY.—A close correspondence exists in the therapeutical applications of the members of the phenol group, and Lichtheim traces a distinct parallelism between their anti-fermentative and antipyretic action. Resorcin, having much less irritating property, is generally preferable to carbolic acid for internal and for subcutaneous use. In *catarrh of the stomach*, *gastralgia*, *ulceration*, and *fermentative indigestion*, Andeer reports on a series of three hundred cases in which it acted most favorably. He prescribed chiefly a three-per-cent solution. In *fevers* it has been given with a view both to its antiseptic and antipyretic actions. It is not a specific, and is only serviceable in the ratio in which it reduces heat. In *erysipelas*, *puerperal fever*, *septicæmia*, and *diphtheria*, resorcin may exert an antiseptic effect. For the same reason it may be applied to the treatment of *ulcerative endocarditis*, but in *intermittent fever*, in which considerable success has been achieved, it remains inferior to the cinchona alkaloids, although coming nearer to these remedies than any other in curative power.

Resorcin has been used by Dujardin-Beaumetz, Andeer, and others, with great success locally in *syphilitic* and other *sores* of an unhealthy or sloughing character. Its solution may be applied as spray in affections of the nose and throat, *catarrhal*, *ulcerating*, or *specific*. Andeer finds it useful in *diphtheritic* affections and in *anthrax*. The later experiences have confirmed the original reports. It is applied freely as powder by insufflation, and, as it has very slight causticity, no ill result follows, and a powerful germicide action takes place.

Phenoresorcin.—By the term *phenoresorcin* is meant, by Riverdin, a mixture of carbolic acid and resorcin : sixty-seven parts of the former and thirty-three parts of the latter. This mixture crystallizes by cooling, and on the addition of ten per cent of water becomes a liquid which mixes with water in all proportions. Combining thus the virtues of both remedies, phenoresorcin offers many advantages, and may well repay more elaborate investigations.

Hydroquinon and Pyrocatechin ; Kairine and Kairoline ; Chinoline.—In the search for an artificial quinine, produced by a synthetical process, various substances, more or less closely related, have been formed. Of these, hydroquinone and pyrocatechine are very similar in all respects to resorcin. They correspond in physiological actions, and have the same power to depress febrile temperature. They are also closely allied to quinine chemically, and possess distinct antiperiodic power. When first produced, they were proposed as substitutes for quinine; the close chemical relationship was supposed to imply an equally close physiological affinity. Further studies have shown that, while these agents are very useful, they are inferior in all respects to quinine. Hydroquinon and pyrocatechin are very closely allied to resorcin.

The actions of kairin, hydroquinon, etc., have not proved satisfactory, and so much depression has been caused by them as to be dangerous. The more recent and manageable remedies, considered further on, have now displaced them entirely.

Kairin is a powder having a pale buff color, is slightly soluble in water, and has a bitter, somewhat aromatic, and, to most persons, a very disagreeable taste. If inclosed in a wafer, which is the most agreeable mode of administering it, a quantity of water should be taken after it, to prevent the caustic action on the mucous membrane.

Kairolin is, chemically, methyl-hydride of chinolin. It is very much less active than kairin, but the effects when produced are more lasting. The dose of kairin, as an antipyretic, is from fifteen to thirty grains, given in anticipation of the febrile rise, or it may be administered in smaller doses at intervals—for example, five grains every hour, until the desired impression is effected. Kairolin, being less active by half, must be given in corresponding quantity.

Chinolin.—So long ago as 1834 this substance was separated from coal-tar by Runge, and given the name *Leukoline.* Subsequently it was obtained by Gerhardt from the cinchona alkaloids, and by him the name *chinoline* or *quinoline* was assigned to it. Lately, chinolin has been produced synthetically by Skraup, by acting on aniline or nitrobenzol with glycerin in the presence of some dehydrating agent. Thus prepared, chinolin is an oily, highly refracting liquid and basic substance, which combines with acids to form salts. All of the salts, except the tartrate, are very deliquescent, crystallizing with difficulty, and soon losing their form; but the tartrate is in lustrous crystals, stable even in a damp atmosphere, and yet sufficiently soluble in water. According to Donath, chinolin is not more closely allied to quinine in physiological and therapeutical actions than it is chemically. Although these confident expectations, that in chinolin we have an adequate substitute for quinine, have not been realized, this remedy is still entitled to be regarded as a valuable antiseptic and antipyretic. Donath has shown that a two-per-cent solution will prevent the development of bacteria in decomposing solutions. Its power to reduce febrile heat is the same as that of the other agents of the group, except that it is greater. Indeed, chinolin is supposed to be nearly as active as quinine as an antipyretic. All of these phenol derivatives and congeners—resorcin, hydroquinon, pyrocatechin, chinolin, etc.—possess the power to reduce fever-heat, while they are powerless to affect the normal temperature. The fall of temperature is preceded by a short period of excitement—of increased rate of cardiac movement, warmth of the surface, flushing of the face, etc.; then perspiration begins, the temperature declines, the pulse slows and becomes weaker, and the respirations lessen in number. The degree of antipyretic effect, and its duration, vary with the different members of the group.

Thallinum.—Thallin. This is a proprietary designation to take the place of the difficult chemical name—*tetrahydroparamethyloxyquinoline.* It must not be confounded with *thallium*, the name of one of the elements.

In its natural state thallin is a liquid, oily substance, having strongly basic qualities. It combines with acids to form salts, which occur in crystals. We have thus *thallini sulphas*, *thallini hydrochloras*, *thallini tartras*, etc. The salts are soluble in water, the sulphate in the proportion of one to five, and more freely in boiling water. The dose ranges from two to five grains.

As respects physiological action, thallin corresponds to the other members of the series; it is antipyretic and analgesic. It is very active in reducing febrile temperature, the decline beginning within an hour, and reaching the lowest point in about three hours, when reaction sets in. A sweat is followed by a rigor, which announces the beginning of a rise in temperature. The amount of sweating corresponds to the dose, and the chill is more or less severe accordingly, but neither of these symptoms is as pronounced as they are in the case of any other remedies of the same group. The action of the heart and the respiration are reduced correspondingly to the amount of thallin administered, and the blood-pressure falls also in the same ratio. A toxic dose arrests the heart in the diastole. The effects of thallin on the blood are similar to those of the other agents of this class: it decomposes the hæmoglobin, and the blood assumes a brownish tint. In this way the respiratory function of the blood is impaired, and hence the temperature falls, the excretion of urea lessens, and the exhalation of carbonic acid diminishes. It does not lessen to any considerable extent the sensibility of the sensory nerves, nor is it an active hypnotic. Toxic doses in animals cause insensibility and muscular resolution. Thallin is not an analgesic. It can not be administered for a long time or in large doses without risk of inducing asphyxia from destruction of the hæmoglobin and arrest of the respiratory function of the blood.

THERAPY.—Thallin is an antipyretic and an antiseptic. It has been used in *typhoid fever* as a means of reducing the temperature. It is very certain, but some disadvantages attend its action. If considerable doses—five grains to fifteen grains a day—have been given, with the decline in temperature there occurs a more or less profuse sweat, and chills usher in another pyretic stage. Its utility is doubtful in typhoid fever. In other febrile maladies, in *acute rheumatism*, *erysipelas*, *tuberculosis*, etc., the reduction of temperature promptly follows the exhibition of thallin; but the effect is maintained for three or four hours only, and then occur the sweats and the chills announcing the beginning of another febrile movement. It has no pain-relieving power in acute rheumatism or other rheumatic affections, although it reduces the temperature.

Steffen praises the action of thallin in the febrile diseases of childhood. He gives one half grain to two grains twice or three times in the twenty-four hours. As the salts of thallin, preferably the sulphate or tartrate, are soluble in water, they can be administered hypodermatically. The effect is much more powerful when given in this way. When taken by the stomach, if considerable doses are required to lower the temperature, Erlich finds it better to give small doses more frequently, instead of a few large doses at longer intervals.

Salicetol.—This is a combination of acetol and salicylic acid. It occurs as a white crystalline powder, having a bitter taste, but is odorless, and is but slightly soluble in water. It is free from toxic properties, and is claimed to be innocuous even in the largest doses. It is an efficient antiseptic, and when brought in contact with a wounded surface it is resolved into its constituent parts, without changing the structure of the parts to which it is applied. Compared with salol, salicetol contains more salicylic acid.

Salophen.—Acetyl-para-amido-salol. A non-toxic compound, being an effective substitute for salicylic acid, and having none of the unpleasant after effects of that agent. It is given in doses of sixteen grains, in wafer or capsule, three or four times a day. It has proved especially useful in influenza, in acute rheumatism, sciatica, neuralgia, chorea, etc.

Further clinical experiences must demonstrate the relative therapeutical value of these combinations.

Salol.—The name applied to this agent harmonizes with such as *phenol*, *naphthol*, and others, now in general use. It is a salicylate of phenol. As it appears in commerce it is a white powder, having a crystalline structure. It is entirely insoluble in water, and hence, when first used by Georgi in the form of powder, its antiseptic powers remained undetermined. It is made by combining salicylic and carbolic acids—sixty of the former and forty of the latter by weight. The insolubility of salol in water explains its lack of taste. It is asserted that it is equally insoluble in the gastric juice, but dissolves freely in the intestinal juices after the pancreatic has joined. More recent observations throw doubt on this assumption, and show rather that the separation into its constituents begins in the stomach. If, however, the greater part of the carbolic acid remains in the combination until the small intestine is reached, no irritant effects occur in the stomach, and at the moment it is freed it possesses the maximum antiseptic power (Nenki and Sahli). Dose, gr. v—ʒ j.

Properties—Actions and Uses.—Salol can be administered in the form of compressed pellet, of powder, pill, or wafer, etc., and as it continues intact during its stay in the stomach, can be so timed in its administration as to act on the intestinal mucous membrane only, or at any stage of the process of intestinal digestion. Salol is the most advantageous if not the most powerful germicide. The temperature of the body has been reduced by it from 104° Fahr. to 98° (Nenki, Lepine, etc.). In common with all the antipyretics, the decline in the body-heat is coincident with sweats, more or less profuse, but not the exhausting sweats accompanied with profound depression of the vital powers—the collapse, even—which are caused by many of the same group. Furthermore, salol differs from many of the antiseptic antipyretics in that the rise of fever after the period of apyrexia is not signalized by a chill, a rigor, or a pernicious cold stage. In general it may be asserted that salol is free from any toxic action, although it may be shown hereafter that there are certain subjects affected in a very unfavorable manner by it. Although idiosyncrasy is by its nature exceptional, it should not be forgotten that the symptoms present under these circumstances are but exaggerations of natural conditions, and are present, probably, in all cases, yet, for the most part, are not recognizable because too minute and ill-defined.

We owe the discovery of the analgesic property of the chinoline derivatives to Lepine, to Sée, and several Russian observers (Todorsky). Therapeutically, the anodyne property of salol is exhibited in the cases that are rheumatic in source. It has also been shown to lower the reflex function of the spinal cord, and thus to abate spasm.

After the decomposition of salol in the intestine—a chemical change wrought by the pancreatic juice—its component elements are no doubt disposed of in accordance with their individual affinities.

Under the continued administration of salol, the urine changes in appearance just as it does when carbolic acid is the agent undergoing elimination. We can not conceive the possibility of Nenki's assertion being true that the carbolic acid when set free in the intestine forms combinations that do not enter the blood. When the quantity of carbolic acid absorbed is large, the urine becomes darker, and finally almost black in color. The test for carbolic acid and salol is the same—i. e., a solution of perchloride of iron, which strikes a fine violet color on being added to urine containing them. Hence it is proved that carbolic acid has passed from the intestine through the kidneys into the urine. The intermediate combinations formed are not well known, but it is probable, of course, that when liberated in the small intestine it must pursue the course its chemical relations require, as we have before stated.

The dose of salol varies with the circumstances—the maximum, when its antipyretic effects are to be produced, being about sixty grains. For other purposes from five to ten grains usually suffice. Although not manifesting any toxic activity when administered in the doses mentioned, it is quite inconceivable that an agent containing so much carbolic acid, liberated in the intestine, should not have the powers of a poison if given in sufficient amount. We repeat the caution already given, and advise our readers to avoid any excess in prescribing it for the purposes to which it seems to be so well adapted.

THERAPY.—If the intestinal reaction asserted by Sahli really occurs, a rational explanation is thus afforded of the curative action of salol in catarrhal states of the intestinal mucous membrane. In *duodenal catarrh*, *catarrh of the bile-ducts* and gall-bladder, in *inspissation of the bile*, and in *jaundice*, it must prove one of our best remedies, if the observations thus far made are confirmed by future experience. It is said to liquefy the bile; hence its remarkable utility in that state of the bile known as inspissation, in which deposits form in the ducts, thus causing at last *occlusion;* but, unlike calculi in this respect, the masses of inspissated bile occlude slowly, while the calculi block the canal suddenly. By rendering the bile more fluid, salol contributes to the solution of inspissated bile and of calculi, provided there be in the calculus a break in the continuity of its smooth surface (Levachoff).

Salol has also the antipyretic property of its congeners, probably in a higher degree than any member of the group. It is the more valuable as a remedy for *fever*, because it has no taste, and does not disturb the stomach. It has another important advantage: the rise of temperature which comes on after the conclusion of the antipyretic action is not accompanied by the chilliness, the rigor, and that profound depression of the vital powers approaching collapse, which seem to be necessary to the action of some—of nearly all, in a greater or less degree—of the newer antipyretics.

The first triumphs of salol were won in the treatment of *acute rheumatism*, excelling, as it apparently does, all other remedies in its power to abate pain and lessen fever. If all the conditions be propitious, by the end of the second or third day fever and joint-pain and swelling will have disappeared; but the rule of practice applicable to all other remedies is equally applicable to salol—that it is necessary to keep up the remedy after the active symptoms have ceased, because of the danger of relapses. The duration of the salol treatment is determined by the success in avoiding relapses for the most part. It does not prevent cardiac complications, any more than do other remedies. The author has reason to believe, indeed, that a larger percentage of the cases now present the evidences of heart mischief since the use of remedies which so much try the heart by their action on the vascular tension.

It is now quite certain that salol and other remedies of the same class have the power to relieve the pains of *locomotor ataxia* in a remarkable degree. This fact is the more interesting because heretofore only the ordinary anodynes were available for this purpose. Recent experiences have brought to light, also, that the antiseptics—chinoline derivatives—have analgesic power of a peculiar kind, in that they afford remarkable relief in painful affections due to a pathological condition of the peripheral nerves, such as that present in locomotor ataxia, *neuritis*, etc. In this group we may include the cases of genuine *migraine*, and that large and indeterminate class, called *rheumatic*, of which *lumbago*, *sciatica*, and *myalgia* are representatives. The dose of salol for these purposes will be from three to ten grains, three or four times a day.

The topical applications of salol are deduced from its physiological actions. It is applied in the form of powder, dusted on the surface or blown on by an insufflator; in solution dissolved in alcohol, turpentine, or cotton-seed oil, and mixed with vaseline or other fats. As it has no odor, and is more effective than iodoform, its utility is evident. It can be mixed with iodoform or iodol, and thus the actions of both may be carried on simultaneously.

Admirable results have been obtained from it in *ozæna*, *otorrhœa*, *gonorrhœa*, in *chancre*, and *chancroid ulcers*, specific and common.

If the experiences of the future justify the statements of the promoters of salol, it will prove a valuable addition to the resources of therapeutics, especially in the numerous morbid states where a germicide only can remove the source and cause of all the mischief.

Antipyrin.—The chemical name of this remedy is *dimethyloxyquinizine*, which is so unmanageable that it could hardly be brought into general use. The original discoverers and promoters of the new agent bethought themselves to name it antipyrin, which is at the same time a convenient designation, a trade title to protect the proprietary rights, and a word significant of the most important property possessed by the new remedy.

PREPARATIONS AND PHYSIOLOGICAL ACTIONS.—Antipyrin is a whitish or grayish-white crystalline powder, slightly but not persistently bitter in taste, and is soluble in water in equal parts by weight. It has basic properties, and combines with acids to form salts. The dose is determined by the uses to which it is applied, and varies from five to sixty grains—the maximum employed to reduce fever-heat. When massive doses are given, it is better to divide into smaller sections, and administer at short intervals, that the impression may be made as a unit. Having ready solubility, it may be prescribed in a solution, or injected subcutaneously.

Antipyrin does not irritate the stomach, but is a stomachic tonic, and the appetite is increased rather than diminished. On the intestine it acts as an antiseptic, inhibits microbes, and thus prevents fermentative changes. It is probable that it increases secretion, and stimulates the intestinal peristalsis also.

Antipyrin diffuses into the blood promptly, and, when the quantity is sufficient, brings about important changes in its constitution; the corpuscles are altered in form, the hæmatin separated, and the whole mass of the blood assumes in consequence a chocolate tint. On the organs of circulation the first effect is excitant in character, but it is brief in duration; the heart-beat is quicker; there is a flush, and a subjective sensation of warmth. Then perspiration begins, and may be very profuse; the pulse lessens in frequency; a sense of chilliness or a chill accompanies the pallor of the surface, and the temperature declines from one to five degrees according to the nature of the seizure and the doses given. In some instances the decline in body-heat passes below normal, but this result is observed more frequently when some other of this antipyretic group is used. The decline of the febrile heat begins in ten to twenty minutes after the dose has been given, and it persists from an hour to sixteen hours or longer according to circumstances. The normal temperature of the body is not affected, how large soever are the doses administered.

Antipyrin appears to be free from one source of danger common to the germicide antipyretics—the profound depression, almost collapse, which comes on with the sweating and precedes the next exacerbation of the fever, and in fact ushers it in. Although antipyrin is free from this dangerous depression, as a rule, there occur in certain subjects, with the sweating, some cardiac weakness and irregularity, of an unpleasant character, and hence it can not be asserted that this member of the group is free from the dangers inseparable from the action of the others, but it is far less toxic.

Antipyrin rather lessens the reflexes, and it possesses some analgesic property corresponding to that of the class.

It is eliminated chiefly by the kidneys, and induces the changes in the urine characteristic of the group to which it belongs.

THERAPY.—Having been discovered by Knorr, the power to lessen febrile heat was first investigated by Filehne, Schmidt, Naunyn, Gerhardt, and others. It was soon ascertained that antipyrin is an effective remedy for fever, the best, up to the present time, for the relief for that symptom, but not possessed of any power to alter the morbid condition producing the feverish state. As Huchard has happily expressed it, "Antipyrin is an antipyretic, but not an anti-periodic." It has been proved to have special power to reduce the *high temperature of tuberculosis.* It does not act with equal advantage in all cases, and inattention to the proper mode of administration will impair its usefulness. The experience thus far gained has shown that a few full doses will have a more happy effect than numerous small doses; but in either case, the periods of apyrexia, especially the sweating stage, are not suitable, and if administered at these times there is danger of upsetting the stomach and increasing the cold sweat. Fifteen grains after the onset of the fever, and repeated two or three times in as many hours, according to necessity, is the best mode of giving it.

Although antipyrin is the most efficient antipyretic in cases of tuberculosis, it does not change existing morbid states. The reduction of temperature effected by it lasts six to twenty-four hours, according to the quantity given, the susceptibility of the patients, and other circumstances, and when the elevated temperature comes on again it may continue for several days below the general level of the fever previously (Huchard).

The published experience in the great journals of professional opinion, in respect to the utility of antipyrin in *typhoid*, now constitutes a vast literature of itself, and we can utilize here only the epoch-making papers. That antipyrin is a safe and efficient antipyretic in typhoid is generally admitted, but no one takes the position that it has a curative effect, or that the reduction of temperature has any influence of a permanent character on the dangers or duration of the fever. In the condition of hyperpyrexia its timely administration has proved very beneficial.

In the symptomatic fevers, such as *pneumonia*, the action of antipyrin has not been favorable, although reduction of temperature is a very constant result of its administration. In no form of febrile disease has it been so efficient as in *acute rheumatism*, and here it maintains the first place as a remedy in this disease, unless the advent of salol shall consign it to the second place. In acute rheumatism it is superior to the salicylates, and to other remedies, unless salol prove more efficient. From fifteen to twenty grains, every three to six hours, will be required until the cessation of joint-pain and the disappearance of the swelling. Under the action of antipyrin, as has been the result from all other remedies, a tendency to relapse is observed in a proportion of the cases, and hence persistence is necessary in the use of the remedy for some days after the attack has apparently ceased, but the amount given should be slowly reduced.

Antipyrin has the same power to reduce temperature in the *malarial* as in other fevers, but no power to prevent paroxysms—no antiperiodic quality. Hence it can never be used successfully in *intermittent and remittent fevers.*

The antipyretic quality, which at the outset was supposed to be the one attribute of the chinoline derivatives, has proved to be less valuable than the analgesic property, which they all possess to a varying extent. When Filehne demonstrated the antipyretic actions, he did not pursue the investigations into the effects of antipyrin on the nervous system, and the clinical studies which followed immediately throughout Germany (Guttmann, Bielochowsky, Pibram, and others) were occupied with its influence over the temperature in the course of the more important fevers.

The remarkable relief afforded by antipyrin and other members of the group in acute rheumatism led to their use in cases of neuritis, sciatica, and some other painful diseases. We are indebted to Professors Lepine and Huchard more especially for demonstrating the influence exerted by these agents over certain painful affections. It seems quite clear that the relief given is in maladies due to central and peripheric lesions of the nerve apparatus—for example, the pains of *locomotor ataxia*, *neuralgia* of the fifth nerve associated with neuritis, and *sciatica* due to the same cause.

Affections of a painful character are amenable to the action of antipyrin in proportion to the rheumatic influence or diathesis dominating them. By subcutaneous injection, it has proved to be very effective in many painful affections that have their seat in the nerves.

The members of this group of remedies have the power to diminish the reflex function, and hence have been used in the various spasmodic affections, as *epilepsy*, *chorea*, etc., with a measure of success, but not in so great a degree as to become substitutes for other tried remedies.

Salipyrin.—By the combination of salicylic acid and antipyrin is produced a crystallized powder having many of the qualities of both ingredients. The dose varies from five to thirty grains three or four times a day. The diseases in which it is employed are acute rheumatism, sciatica, meningitis, migraine, dysmenorrhœa, and other affections.

Methylene Blue.—Pyoktanin blue is one of the anilin colors, utilized by its proposers as an antiseptic, under the name *pyoktanin*, so called because of its power to restrain suppuration. It was first employed by Stilling, who demonstrated the property to inhibit the organisms of suppuration, for which he employed solutions of 1 to 1,000, to 100.

In its physiological actions pyoktanin corresponds to the other derivatives of the series, but it has some special powers. Taken by the stomach it is apt to cause vomiting, or rather regurgitation, the contents of the stomach coming up without effort. What is brought up thus is stained a deep purplish color. There is more or less staining of the whole canal. It is very diffusible. When applied to an ulcerated surface it passes into the cells and arrests their growth.

When it enters the vessels it decomposes the hæmoglobin, colors the blood a chocolate tint, fixes the blue in the blood-corpuscles, the liver-cells, and the mucous membrane of the gall-ducts, and the whole body acquires a bluish-purple coloration. It lowers the blood-pressure, lessens the respiration, diminishes the sensibility of the sensory nerves, and is more or less hypnotic and antipyretic. It has, however, so much toxic action on the blood that it is not likely to be employed in the class of cases in which acetanilid, antipyrin, and others have been of late so successfully employed. The pain-relieving power of pyoktanin has, however, been made available by Immerwahr, who employed it successfully at Briegel's policlinic in *trigeminal neuralgia*, *migraine* (alcoholic), *muscular rheumatism*, *herpes zoster*, and *sciatica.* Vicutic employed pyoktanin by subcutaneous injection (a syringeful of a two-per-cent solution) in the same kind of cases as those just mentioned, and also in pill, one to three grains, in headache, alcoholic neuritis, acute rheumatism, the pains of locomotor ataxia, etc.

It is, however, as a topical application to suppurating surfaces, to ulcers and cancer, that pyoktanin has been employed with the greatest advantage. In the hands of Mosetig-Moorhoff it has proved to be a remedy of real value in the treatment of *cancer*—if not curative, at least distinctly retarding the growth and changing its aspect. For this purpose a solution of the strength of 1 to 500, or stronger, is injected beneath and about the tumor and into its substance. There can be no doubt that it diffuses into the cellular elements, so that they lose their vitality and the morbid action is arrested. In *gonorrhœa*, an injection of pyoktanin is highly effective ; it is especially destructive of the gonococcus. A solution of 1 to 1,000 is about that ordinarily required. Pyoktanin has also been used with success in the treatment of carbuncle, abscesses, and suppurative process of the ear and other parts.

Dr. Ferreira, of Rio Janeiro, has employed pyoktanin with success in the treatment of intermittent fever in infants. It is easily administered, and causes no nausea or vomiting. It acts, he supposes, on the germ characteristic of the malarial disease, and also as an antipyretic. Ehrlich and Guttman assert that this agent colors the plasmodia, prevents their development, and causes them to disappear gradually ; but other observers dispute this fact.

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Naphtalin.—According to Fronmüller, *naphtalin* (or *naphthalin*) was discovered so long ago as 1820, but its applications in medical practice have been developed since the subjects of antiseptics and bacteriology have assumed so important a place in modern pathology and therapeutics. It is now obtained in quantity from a by-product of gas-manufacture, and after purification appears in commerce in the form of rather brilliant, rhombic crystals, having a somewhat aromatic but acrid, burning taste. It is not soluble in water, but dissolves in ether and acetic acid.

The best form for the administration of naphtalin internally is the compressed pellet, and this form secures the preservation of the drug as well as facilitates the administration. Naphtalin may be combined with any aromatic powder—for example, the official *pulvis aromaticus compositus*, powdered nutmeg, or cinnamon—and given as a powder. The dose ranges from one quarter of a grain to five grains.

Naphtalin does not distress the stomach nor cause nausea, the present experience being that it is rather a stomachic tonic. It is supposed that it passes unchanged from the stomach into the intestine, where it acts as an antiseptic. The proof of this action is afforded by the complete deodorization of the stools. To remove the fecal odor from a mass of fæces implies the possession of great powers, and is conclusive as to changes occurring in the naphtalin itself. It follows that the fermentative processes producing more or less of the offensive compounds of sulphur, phosphorus, and carbon, must be arrested by naphtalin.

Although insoluble in water, this remedy diffuses through the body, and ultimately escapes in part from the lungs and kidneys, but largely in the fæces. It has some mysterious influence on the function of nutrition, or on the trophic nervous system, for, when given to dogs freely, cataracts form. No such result can be expected from its medicinal use in man; but a judicious practitioner will hardly risk such a result by large doses, protracted administration, and careless observation.

The therapeutical applications are based on the studies that have been made of its physiological actions; they are both internal and external. Dupasquier advises the following solution for the stomachal administration: Naphtalin, ℈j; dissolve in boiling alcohol and add sufficient simple sirup to make up to eight ounces. A tablespoonful can be taken three or four times a day. This formula is said to be an excellent expectorant, and to remove the fetid character of the pus in some cases of *bronchorrhœa.* The most important of the internal uses of naphtalin is in the treatment of *diarrhœa, dysentery, round worms,* and *typhoid.* Rossbach has found it very useful in the first two, and the author has had excellent results in some cases of chronic dysentery. Also, it has appeared to the author to be of great relative utility in the cases of diarrhœa due to obstruction of the portal circulation. In *chronic dysentery* and *diarrhœa, acute* and *chronic,* it has proved very successful in the practice of Dolgopoloff.

Naphtalin has an effect on the genito-urinary tract, in passing through in the urine, which is of no little service in catarrhal states of the mucous membrane, in *pyelitis, cystitis,* etc. Offensive urine is sweetened by it, and hence an impression is made on the catarrhal process. On the other hand, Prof. Rossbach asserts that in certain subjects its administration for other purposes may excite a violent cystitis with strangury, and that it must be administered with caution when the kidneys are damaged.

The external uses of naphtalin consist in applications to *ulcers* (syphilitic, varicose of the leg, or other unhealthy and sloughing forms), in leucorrhœa of a fetid character, in gonorrhœa and cognate affections. Fronmüller asserts that he has had "marvelous results" in some cases of *bed-sores* caused by prolonged decubitus. The same authority affirms its superiority to iodoform in these diseases.

In *eczema, pityriasis, psoriasis,* etc., it is often highly beneficial. An ointment with vaseline (1 to 3) is recommended when there is intelligent supervision.

Naphtol.—There are two naphtols, derivatives of naphtalin, but *beta*-naphtol is the one prescribed.

Beta-Naphtol.—A phenol occurring in coal-tar, but usually prepared artificially from naphtalin. It is used in the form of ointment with vaseline dissolved in alcohol, ether, or in olive-oil, in the proportion of two to ten per cent. Although not soluble in water, it is readily diffusible, and may bring on toxic symptoms if too lavishly applied to a fresh surface. The character of its toxic effects is similar to those of the other members of the group, and need not be described here.

Asaprol.—A derivative of naphtol β. This new remedy has been carefully studied from the clinical standpoint by Dujardin-Beaumetz and Stockler. As it offers many advantages over other antiseptics of this group, some notice of its actions and uses is desirable. The dose for adults ranges from one to ten grammes (15 grs. to ʒ ij). It is best administered in the form of wafer or capsule, or, as it is very soluble, in solution in some aromatic water with sirup. It does not disorder the stomach nor cause headache, vertigo, or singing in the ears. Dyspeptics take it without any increase of their symptoms, but rather with relief to some of them. It has been administered in subjects affected with albuminuria without adding to the renal mischief. It has been taken by persons unable to tolerate sodium salicylate, quinine, and antipyrin. There is consequently a wide range of applications of asaprol where remedies of corresponding powers can not be administered.

Asaprol is an analgesic and antipyretic. In *acute rheumatism* it has proved to be as efficacious as the sodium salicylate, and it is far better supported by the patient. The daily amount required has ranged between ʒ j and ʒ iij, the individual doses being one gramme (15¼ grs.). In certain infectious maladies, as *typhoid fever*, *influenza*, etc., it has been specially useful. In *intercostal neuralgia* and *neuralgia* of the dental branches of the fifth nerve it has afforded prompt relief. Again, in *sciatica* it has acted favorably. Neuroses, of which asthma is a type, have proved amenable to its action.

Pyridine.—*Pyridine* is a volatile liquid, having a strong, diffusive, and somewhat aromatic odor. Its vapor is given off at ordinary temperatures, and its therapeutical effects are obtained by inhalation. We owe the valuable suggestion of its inhalation for certain purposes to Prof. Sée, who ascertained that it acts on the reflex function of the cord, and also on respiration. The special purpose for which it is prescribed is the treatment of *asthma*, and this condition is relieved, what cause soever may have developed it. The manner of its employment is simple: it consists in placing a saucer containing some pyridine (ʒ j, for example) in a large closet or small room that can be tightly closed, the patient remaining in it for twenty to thirty minutes, and repeating the same procedure two, three, or five times a day as may be necessary. In simple asthma a cure may be effected in ten to thirty days, and in symptomatic asthma, emphysema, etc., remarkable relief is obtained. Prof. Sée does not advise pyridine as the sole remedy, for the iodides constitute the true curative means, in his belief.

With the inhalation of pyridine vapor can be combined ethyl iodide, the latter contributing the iodine which is so effective of itself in many cases of asthma.

Pyridine has basic properties, and forms crystallizable salts with acids, which, however, are somewhat unstable. It mixes with water in all proportions, but, as it is exceedingly volatile, should be prepared as required. The dose for internal use is from five to twenty minims. Exhibited in this way, it increases the power of the cardiac contractions, raises the tension, and greatly lessens respiratory embarrassment. Its action resembles that of digitalis, for which it may often be substituted with distinct advantage (De Renzi). The salts can be used in lieu of the volatile pyridine in many cases.

Phenacetin.—Among the more recent contributions to the antiseptic and antipyretic group, *phenacetin* is the most promising. Although without danger in the dosage necessary for therapeutic purposes, some persons suffer from the sweating, chilliness, and weakness, which occur in a greater degree when the other members of the group are used. The dose of phenacetin ranges from ten grains to thirty, in twenty-hour hours, and three grains every two, three, or four hours will have sufficient effect on febrile heat for the most part. It is little soluble in water, and is best given in wafer, capsule, or powder.

Comparing phenacetin with other well-known remedies of the same class, it is found that a dose of ten grains is equal to one of fifteen grains of antipyrin, of quinine, and of kairin—to thirty grains of salicylate of soda and thirty grains of thallin. Dose for dose as compared with antifebrin (acetanilid), it is as effective in reducing heat, but the action is less prompt, and yet it endures longer.

The action that confers on phenacetin its antipyretic power is the change in the composition of the red blood-globules, whereby the oxidizing effect carried on by these bodies is lessened or arrested entirely. It is poisonous to animals, but not to man [*Malmert*, *Dujardin-Beaumetz*, and others].

Phenacetin is a remedy in rheumatismal affections of the first order. In fevers, as an antipyretic, and as an analgesic in painful affections, it is as useful certainly, if not more so, than any other of these remedies.

Saccharinum.—Saccharin, as it has been happily named, is, in chemical language, *orthosulphaminbenzoic acid.* The name is based on the most important physical quality—the sweetness—but it is an acid, and combines with bases to form salts. Thus it displaces carbonic anhydride from its combination with sodium, and forms sodium orthosulphaminbenzoate. As it is more soluble in this form, the taste is sweeter. Internally it may be prescribed in the form of powder, or mixed in any food or drink requiring the addition of sweet, and subcutaneously it can be injected in solution in combination with sodium bicarbonate. The dose ranges from 5 grains to ℈j, or more as required.

ACTIONS AND USES.—Saccharin is not sugar, although one of the sweetest substances in nature. It is an antiseptic of considerable power. In the proportion 0·16 per 100 it notably diminishes the activity of the ferment of beer. In a mixture of saccharin (0·32 per 100) and of urine in equal proportions no ammoniacal decomposition occurred for seven days. It retards the activity of the gastric and pancreatic ferments, and it has an inhibiting influence on some organisms, but it does not affect the powers of the spirillum of cholera and other pathogenic organisms. According to Paschkis, the intravenous injection in dogs of a four-per-cent solution is without influence on the blood pressure or on the action of the heart. According to Aducco and Mosso, Salkowski, Paschkis, and others, it is comparatively innocuous in its action on the system, and passes out unchanged by the urine. It does not modify the action of some active agents with which it may be combined: thus saccharin-strychnine and saccharin-cocaine have the effects of the bases. The taste of certain medicaments—as quinine, salicin, tincture of chloride of iron, antipyrin, copaiba and sandalwood oils, guaiacum, hydrastis, and cascara sagrada—is successfully covered by saccharin without impairing any of their qualities (Gans).

The *flatulent colic* of children is, in my experience, often admirably relieved by the giving of saccharin in two to five grain doses after meals. The *intestinal pain* due to the sudden formation of gas, and coming on in two to four hours after meals, may be prevented by the timely exhibition of this remedy. In these cases the remedy may be administered in any suitable food, or be given at such time after meals as may be necessary to secure its admission to the small intestine.

It has also proved beneficial in *catarrh of the duodenum*, catarrh of the bile-ducts, and in *sick headache* due to intestinal indigestion.

It has been utilized as a dietetic agent and substitute for cane-sugar in the treatment of *diabetes*. The mistake is often made of too lavish use of the substitute, so that it comes to pall on the taste, and a disagreeable, mawkish sense of oversweetness remains constantly in the mouth. There is reason to believe that saccharin does good somewhat as a remedy for the hepatic disturbance which underlies the production of glycosuria.

In the experimental trials with saccharin it was found that, given by the mouth, the tendency of the urine to decompose was greatly lessened, and hence it has been proposed to employ it as a remedy in catarrh of the bladder and of the pelvis of the kidney. In some cases good results have followed this practice.

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Acidum Boricum.—Boric acid. *Acide boracique*, Fr.; *Borsäure*, Ger.

PROPERTIES.—Boric acid occurs in glittering, white, scaly crystals. It is soluble in twenty-six parts of cold and in three parts of warm water, and is freely soluble in alcohol.

Glyceritum Boroglycerini.—Boric acid, 310 grm.; glycerin to make 1,000 grm.

ACTIONS AND USES.—Boric acid possesses decided antiseptic and deodorant properties. It arrests fermentations and putrefactive decomposition, and is destructive of minute organisms—bacteria, vibrio, etc. Applied to wounds, it is free from irritating effects; it lessens suppuration, and prevents decomposition.

Boracic acid occupied an important place in Lister's antiseptic method. It appears to be as effective as carbolic acid, and is even less irritating to the tissues than salicylic acid. A saturated solution may be employed as a dressing to fresh wounds to prevent the action of atmospheric germs, or to arrest decomposition in gangrenous, sloughing, or ill-conditioned wounds. "Boracic lint" is made by steeping lint in a saturated solution of boracic acid at the boiling-point; and, after drying, it is found to hold a large quantity of the acid, weighing nearly twice as much as before being thus treated.

Mr. Lister's directions for the application of boracic-acid dressings to *ulcers* are as follows: "The first step is to cleanse the sore and the surrounding skin once for all from septic impurity. This is done by treating the surface of the sore freely with a solution of the chloride of zinc (forty grains to the ounce); and at the same time washing the integument with a strong watery solution of carbolic acid, which is used on account of its remarkable power of penetrating the epidermis, while for the sore itself the solution of the chloride appears to be more efficient. This preliminary step having been taken, the boracic dressing is at once employed as follows: A piece of oiled-silk protective, of sufficient size to cover the sore and slightly overlap the surrounding skin, is dipped in the boracic lotion (a saturated, watery solution) and applied, and over this a piece of boracic lint large enough to extend for an inch or more beyond the protective on all sides, the whole being retained in position with a bandage."

Mr. Lister has used boracic solutions with great success in *pruritus ani, ulcers, skin-grafting, burns* and *scalds, eczema*, in *operations on the penis*, etc. By Mr. Watson, these solutions have been employed with excellent results in the dermatophyta; for example, *tinea tonsurans* and *t. circinata*—especially "in that very troublesome form of the disease which affects the scrotum and inner side of the thigh."

Boracic ointment may be made as follows: "Take of boracic acid finely levigated, one part; white wax, one part; paraffin, two parts; almond-oil, two parts. Melt the wax and paraffin by heating them with the oil, and stir the mixture briskly along with the boracic-acid powder in a warm mortar until the mixture thickens." When required for use, this ointment should be rubbed up with a little glycerin to the proper consistence, and then spread on muslin or linen.

Boracic acid may be employed in all the various forms and combinations in which carbolic and salicylic acids are now used by the antiseptic method.

Borocitrate of magnesia, originally proposed by Becker, has been recently strongly urged by Madsen as a solvent of urinary calculi of the uric-acid variety. It may be extemporaneously prepared as follows: ℞ Magnesii carbonat., ʒ j; acid. citric., ʒ ij; sodii biborat., ʒ ij; aquæ bul., ℥ viij. M. Sig.: A tablespoonful three or four times a day.

Tartraborate of potassium is, probably, a more generally useful remedy for the purpose above indicated, as the potash compounds of uric acid are more soluble than the soda compounds. As a solvent of uric-acid calculi, this salt is preferable. It is obtained by heating together four parts of cream of tartar, one part of boracic acid, and ten parts of water. It is a white powder, or occurs in transparent scales, has an acidulous taste, and dissolves in two parts of cold water. A scruple may be given three or four times a day in water, and the more largely diluted it is, the better when used for the solution of calculi.

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Benzoinum.—Benzoin. A balsamic resin obtained from *Styrax benzoin* Dryander (Nat. Ord. *Styraceæ*). *Benjoin*, Fr.; *Benzoeharz*, Ger.

COMPOSITION.—Benzoin is made up of resins. When subjected to dry distillation it yields *benzoic acid*, which is contained in it in the proportion of fourteen to eighteen per cent. Certain varieties of benzoin contain, also, *cinnamic acid*.

Tinctura Benzoini.—Tincture of benzoin, 200 grm.; alcohol, sufficient to make 1,000 c. c. Dose, ʒ ss—ʒ j.

Adeps Benzoinatus.—Benzoinated lard. Benzoin, 20 grm.; lard, 1,000 grm.

Tinctura Benzoini Composita.—Compound tincture of benzoin. (Benzoin, socotrine aloes, storax, balsam of tolu, alcohol.) Dose, ʒ ss—ʒ ij.

Acidum Benzoicum.—Benzoic acid. Is in white, feathery crystals, of a peculiar, agreeable odor, and warm, acidulous taste, sparingly soluble in cold water, more soluble in boiling water, which deposits it in part on cooling, and very soluble in alcohol. Dose, gr. v—ʒ ss.

Ammonii Benzoas.—Ammonium benzoate. Is in minute, white, shining, thin, four-sided, laminar crystals, with a slight odor of official benzoic acid, and a bitterish, saline, somewhat balsamic taste, and slightly acrid but persistent after-taste. It is soluble in five parts of water and in twenty-eight parts of alcohol. Dose, gr. v—ʒ ss.

Sodii Benzoas.—Sodium benzoate. A white, semi-crystalline or amorphous powder, efflorescent on exposure to air, odorless, or having a faint odor of benzoin, of a sweetly astringent taste, and neutral reaction. Soluble in 1·8 parts of water, and in forty-five parts of alcohol at 60 Fahr. Dose, gr. v — ʒ j.

Actions and Uses.—The physiological effects of benzoin and its preparations are due to benzoic acid. Taken in very considerable doses (ʒ ss), benzoic acid produces some epigastric heat, increases the pulse-rate, and promotes bronchial and cutaneous transpiration. The acidity of the urine is rendered more decided by it. A large part of the acid is excreted by the kidneys as benzoic acid, and a part undergoes conversion into hippuric acid.

Recent observations have shown that benzoic acid has decided antiseptic properties (Salkowsky). It manifests the same power to prevent fermentations and putrefaction, and to destroy minute organisms, as that possessed by salicylic and boracic acids.

The tinctures of benzoin were formerly used as expectorants in *chronic bronchial affections.* They are now sometimes resorted to for the local treatment (by atomization) of chronic laryngeal affections. Their most important use, however, is in the treatment of *foul-smelling wounds, flabby granulations,* etc. Unhealthy or sloughing wounds may be dressed with linen or cotton cloths saturated with the tinctures, with the effect to destroy fetor and stimulate to a more healthy growth. *Chapped hands and lips* and *fissured nipples* are best treated, according to Stillé, with a mixture of compound tincture of benzoin and glycerin. Benzoic acid may be used as a substitute for boracic and salicylic acids in the antiseptic treatment of wounds. Its solubility in water can be increased by the addition of borax.

Benzoate of ammonia is a remedy of great utility when the *urine is ammoniacal and loaded with phosphates.* Under its use the urine becomes acid, and the fermentative changes are arrested. In *chronic cystitis,* arising from any cause, this remedy should be prescribed when the urine undergoes the alkaline fermentation. *Incontinence of urine,* when due to an alkaline reaction of this excretion, is cured by the benzoate of ammonia. *Phosphatic calculi* may be dissolved by the long-continued use of this remedy.

Benzoate of sodium has lately occupied a large place in professional attention. Having similar antiseptic and antipyretic properties to those of salicylate of sodium, and being without any injurious effect, it came to be largely used in the septic maladies. The first important observations were those of Dr. Klebs, of Prague, who announced that this salt can be used with good effects in all infectious febrile diseases; that while the febrile movement does not cease as quickly as after the use of sulphate of quinine and salicylate of sodium, the results obtained from the benzoate are more permanent. Moreover, absolutely no unpleasant after-effects were observed from this remedy, even when its use was much prolonged, and as much as three hundred and eighty grains daily could be taken without inconvenience. The usual daily quantity required in the treatment of diseases is ten to fifteen grammes, or one hundred and fifty to one hundred and eighty grains. Dr. Klebs advised the use of benzoate of soda in the acute infectious diseases, in tuberculosis, and catarrh of the bronchi. The principle underlying these suggestions of Dr. Klebs is the antiseptic. He holds that the maladies in question are of parasitic origin. The appropriate remedy is an antiseptic, destructive of germs. There are several remedies having these powers, but benzoate of sodium is best, because, while very destructive of minute organisms, it is free from injurious effects on the body. A remarkable and sudden extension was given to the use of this salt by the report from Innspruck, that cases of consumption far advanced were being quickly cured in the clinic of Prof. Propop Rokitansky. Subsequent investigations proved the inaccuracy of such observations. Klebs held that he had proved the parasitic origin of phthisis, and Prof. Schüller, of Greifswald, confirmed his statements by additional experiments. It was discovered in Klebs's laboratory that, if animals were made to inhale the spray of benzoate of sodium, tubercular and diphtheritic matter did not affect them. Then followed the treatment of cases of *consumption*, by spray of a solution of the benzoate. Although the first claims put forth were greatly exaggerated—not entirely unfounded—there is reason to believe that the free use of benzoate spray is of service in some cases of consumption. According to the estimate of Rokitansky (Propop), the patient must inhale $\frac{1}{1000}$ of the body-weight daily of the benzoate in the form of spray, to do any good. Among the numerous observations in opposition to the views of Klebs and his followers, may be selected those of Guttmann, who found that the treatment did not relieve a single symptom, and that there was no appearance in the affected lungs of any attempt at reparation.

Benzoate of sodium has been used in other infectious diseases. Thus Letzerich has employed it with success in the teatment of *diphtheria*. Of twenty-seven cases treated with this remedy in one epidemic, only one proved fatal, and this was an infant of feeble constitution. He gave from five to twenty grammes daily (seventy-five to three hundred grains), according to age, and applied the powdered benzoate by insufflation to the diseased parts. Other physicians have not been so largely successful, but many very favorable reports have been published (Kien, Hoffmann). Thus Demme found it highly serviceable in *diphtheria* and *scarlet fever*. It is well established that benzoate of sodium, added to the diphtheritic fungus, renders it harmless, so that the local use is founded on sound reasons. As an antipyretic in the *eruptive fevers*, in *typhoid*, and in *malarial fevers*, this salt may be preferred to the salicylate, than which it is safer, although much less effective as an antipyretic. In *acute rheumatism* it has been administered by Senator, McEwan, and others, who have found it a good and safe remedy, but not so active as salicylic acid. Tordens has treated *whooping-cough* successfully, using the prescription of Letzerich : ℞ Sodii benzoat., ℈iv; aquæ destil., aquæ menth. pip., āā ʒ x; syrup. aurantii, ʒ ij. M. Sig.: Two drachms every hour or two.

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Acetanilidum.—*Acetanilid* (Antifebrin).—An acetyl derivative of aniline. The term *antifebrin*, by which acetanilid is best known, is a proprietary designation; acetanilid is a more scientific term, unrestricted in use, and hence should be preferred. Also, the name antifebrin expresses but one, and not the most important, of its powers.

PROPERTIES—PHYSICAL AND PHYSIOLOGICAL.—Acetanilid is a white, crystallized powder, without odor, and having a slight, characteristic, but not disagreeable taste. It is soluble to some small extent in cold water, 1 part to 194; more soluble in warm water, 1 part to 50 of water at 105° Fahr.; and dissolving readily in alcohol (3·5), in ether (6), and in chloroform (7). Chemically, acetanilid is *aniline*, less an atom of hydrogen replaced by acetyle. The dose ranges between four and eight grains. The latter quantity need rarely be exceeded in a single dose, but a considerably larger amount can be safely administered in twenty-four hours. Drachm-doses have been taken by healthy persons without suffering. There are important differences in the action of moderate medicinal and of toxic doses (Weill), for the effect of the latter on the blood-globules introduces a special pathogenic influence which must change the character of the symptoms produced.

Ordinary medicinal doses do not irritate the stomach, and indeed, as the author has observed, sometimes allay nausea. Notwithstanding its insolubility, acetanilid rapidly diffuses into the blood. The normal constituents of the blood are quickly changed in composition; the oxyhæmoglobin lessens in quantity, and a corresponding formation of methyhæmoglobin takes place. The effect of such changes is to seriously modify that function entitled the "ozonizing function," and to impair constructive tissue metamorphosis, and with it heat-production. The effect of full medicinal doses in this way is partly manifested in the cyanosis usually present, but, as no ill result occurs, it is certain that the change is only temporary. The reduction of temperature takes place only when fever is present, and no action follows the administration of the remedy during apyrexia. It results from this fact that, to obtain the fullest effect from acetanilid as an antipyretic, it should be given at the point of maximum elevation of temperature.

Acetanilid raises the intra-vascular blood-pressure, chiefly by contracting the peripheral arterioles, and thus increases the work of the heart. As the vascular tension rises, the heart-beats lessen in number, but gain in force After a time, as is the physiological law, the stimulation of the cardiac motor apparatus is succeeded by diminished action and irregularity of the rhythm—consequences of a protracted and powerful impression on the centers of reflex action, and of the vasomotor system. It is a curious fact that, in a considerable number of persons, only the effects on the nervous system are produced, and a decline of temperature and failure of respiration are not experienced. The mind continues clear, and vocal expression is not impaired, until the serious changes wrought in the blood bring about coma and insensibility. As the effects of the medicament are developed, the reflexes lessen, and the irritability of motor and sensory nerves and of the pneumogastric progressively declines. Analgesia and anæsthesia are products of its action, but it is evident that the interference in the respiratory function of the blood has much to do with the functional changes occurring in the nervous system.

In the beginning, acetanilid excites increased action in the central nervous apparatus, but, as the impression gains in force, a quantitative decline takes place in the functions of motility and sensibility, and ultimately they are suspended entirely. Large doses have so serious an effect on the red blood-globules that collapse follows a brief period of excitement. As the antipyretic power is due to the injury done to the "ozonizing function of the blood," as has been explained, it is clear that the therapeutical applications for diminishing fever-heat are not without danger, and, although it is an efficient remedy for this purpose, it is probably not safer when the proper dose is exceeded than the other antipyretics of the same character. It is true, to accomplish a given result, so small, comparatively, is the dose required, that it is not necessary to exhibit that quantity which will produce dangerous symptoms. In common with the antipyretics of this class, but far less frequently and severely, acetanilid causes sweating at the end of its impression, and a rigor as the temperature begins to rise again.

Opinions differ somewhat in regard to the certainty and the power of acetanilid as an antipyretic. Eisenhart, Riese, Krieger, and other German observers, find it to be extremely uniform in its effects on febrile heat; but Dujardin-Beaumetz holds that small doses will sometimes have a decided power to lessen the temperature, and, again, quite large doses will fail of effect. He regards it, therefore, as a rather capricious antipyretic, and hence inferior to antipyrin for this purpose, although threatening symptoms are but rarely induced by its therapeutical administration, with the exception of cyanosis, which occurs when the larger doses are given, but does not necessarily indicate an untoward action.

The amount required to produce distinct antipyretic effects ranges from four to eight grains, the latter dose having proved to be an effective quantity for lessening fever-heat in general. A much larger quantity can be given with entire safety, if the circumstances demand the increase. Huber has administered from sixty to seventy grains, and from ninety to a hundred grains in twenty-four hours, without any ill effects. The reduction of temperature begins in one to two hours after the dose has been taken, and the effect is maintained for four to twelve hours.

THERAPY.—The applications of acetanilid to the treatment of diseases are based on its physiological actions. There are two directions in especial that its curative powers take: to lessen fever (antipyretic action); to diminish the functional activity of motor and sensory nerves, and to inhibit reflex actions.

As respects *fever*, when the high temperature must be reduced, acetanilid is effective, and although it may exert less power than antipyrin, has many advantages, in size of dose, ease of administration, and freedom from untoward effects. Its special field of utility is the relief of inflammatory conditions of nerves. In *neuritis*, the author has found it so effective that it has seemed to have specific action. The pains (*neuralgia*, *myalgia*, etc.) due to inflammation of nerves are, as a rule, soon relieved, and the dose for this purpose need not exceed three to five grains *ter die*. In *optic neuritis*, with pain, Dujardin-Beaumetz finds it exceedingly effective, not only in removing the nerve-pain, but in arresting the inflammatory process on which the pain depends. Very admirable results have been had from acetanilid in the *pains of locomotor ataxia*. As all the world knows, these pains have not hitherto been at all readily relieved by the means available, and hence the importance of this recent contribution to our resources. The pains of *herpes zoster*, and of *sciatica* produced by local injury, have also been promptly arrested by this remedy, while no apprehension of a habit has intervened to lessen the satisfaction derived from its curative power.

To Lepine, of Lyons, to whom we owe the first knowledge of the curative power of acetanilid in the affections of the nervous system mentioned above, and to Dujardin-Beaumetz, we are also indebted for the suggestion of its use in *epilepsy*. The experiences and observations thus far accumulated do not warrant the statement of exact formula to guide the administration. That it lessens reflex excitability and opposes spasm is evident, but such an action does not include the whole of its powers. The impression made by acetanilid on the vaso-motor system must be taken into account as an element in its curative action. As it causes contraction of the arterioles, and slows somewhat the heart-beat, it must be more useful in those cases of epilepsy characterized by full habit, active circulation, redness of face, injection of the conjunctivæ, etc., than in the anæmic, the pale and feeble. For similar considerations, it will prove more useful in diurnal than in nocturnal epilepsy, for, as in the state of sleep there is an anæmic condition of the brain, it is probable that an agent contributing to this will only increase the tendency to convulsions.

Exalgine.—By this name a new remedy having valuable anodyne property has been introduced by Dujardin-Beaumetz and Bardet. It is a derivative of acetanilid with methyl, and hence the name, given to designate, not its composition, but its most important curative power. The chemical name is *Orthomethylacetanilid*, which is too difficult and unwieldy for general use. It has proved to be a highly effective remedy for neuralgia, and is free from ill effects. The dose required for internal exhibition in painful affections is determined by the degree of pain and the nature of the cause producing it. As a hypnotic it has proved to be one of the most effective, and this without any of the immediate and remote actions of a disagreeable kind.

Antiseptic Oils.—*Oleum Caryophylli.*—Oil of cloves.

COMPOSITION.—Oil of cloves consists of two substances—a hydrocarbon, *light oil of cloves*, and an oxygenated oil, *eugenol*, which has acid properties, and is therefore called *eugenic acid*. The light oil of cloves is isomeric with the oils of turpentine, copaiba, and cubebs.

Salicylic acid and a camphor known as *caryophyllin* are also constituents of the oil of cloves. Dose, gtt. ij—gtt. v.

Oleum Gaultheriæ.—Oil of gaultheria. A volatile oil, consisting almost entirely of methyl salicylate, from the leaves of *Gaultheria procumbens* Linné (Nat. Ord. *Ericaceæ*). Methyl salicylate or volatile oil of sweet birch can be substituted for oil of gaultheria in dispensing. Dose, ♏ ij—♏ v. x.

Spiritus Gaultheriæ.—(Oil of gaultheria, 50 c. c.; alcohol, 950 c. c.) Dose, ʒ ss— ʒ ij.

Oil of gaultheria has been proposed and used successfully as a substitute for salicylic acid in the treatment of *rheumatism*, *gout*, and affections dependent on these diatheses respectively. It is best given in the form of an emulsion, and it may be combined with other agents having corresponding powers.

COMPOSITION.—Oil of thyme contains a hydrocarbon which, by fractional distillation, is resolvable into *cymene* and *thymene*. Its most important constituent is a solid crystalline substance, having acid properties and homologous with carbolic acid. This is known as *thymol*, or *thymic acid*. Dose, gr. ij—gr. x.

Oleum Cajuputi.—Oil of cajuput. The volatile oil distilled from the leaves of *Melaleuca leucadendron* (Nat. Ord. *Myrtaceæ*). Dose, ♏ v—♏ xx.

COMPOSITION.—The most important constituent of the oil of cajuput is *cajuputol*, or the bihydrate of *cajuputene*.

To this list might be added eucalyptol, the camphor obtained from *Eucalyptus globulus*, and the various balsams, and cymene and terpene volatile oils; but these remedies have already been considered elsewhere, so far as they possess any practical importance.

Thymol.—"A phenol occurring in the volatile oils of *Thymus vulgaris*, Linné, *Monarda punctata*, Linné (Nat. Ord. *Labiatæ*)," etc.

Large, colorless, translucent crystals of the hexagonal system, having an aromatic, thyme-like odor and a pungent aromatic taste, with a very slight caustic effect upon the lips. Soluble in about 1,200 parts of water at 59° Fahr. (15° C.), and in less than its own weight of alcohol; also readily soluble in carbon disulphide, glacial acetic acid, and in fixed and volatile oils. When triturated with about equal quantities of camphor, menthol, or chloral, it liquefies. (U. S. Ph.)

Physiological Actions.—The composition of this group of oils indicates the close correspondence between them and carbolic, salicylic, and benzoic acids. So intimate are the chemical relations of salicylic acid, benzoic and cinnamic acids, that the balsams might with propriety be grouped with the antiseptics, for in their physiological actions and therapeutical applications they are equally as closely related as in their elementary composition.

Of the members of this group, thymol or thymic acid has been most elaborately studied. Lewin has shown that thymol, as respects its influence on fermentation and putrefaction, has a positive antiseptic property. Its actions are similar to those acids of the same class to which it is so closely allied chemically, viz., carbolic, salicylic, and benzoic. Locally applied, thymol, just as carbolic acid, produces paralysis of the end-organs of the sensory nerves (Lewin).

The effects of thymol have also been studied by Baltz. He has ascertained that from twenty to thirty grains a day are necessary to produce distinct effects. Placed in contact with the fauces, it causes an acrid sensation, which persists. It rarely excites vomiting, but a large dose induces a sensation of heat about the epigastrium, and sometimes diarrhœa. In the majority of cases thymol causes, in about half an hour to an hour, sweating more or less profuse, but distinctly less than that produced by salicylic acid and jaborandi. The urinary secretion is sometimes increased. The urine presents a dark, greenish hue, as if it contained blood. This is due to the presence of a decomposition product of thymic acid, and in part of thymol itself, for a portion of that taken escapes unchanged (Blum). Singing in the ears, deafness, constriction of the forehead, are caused by full medicinal doses, and a considerable decline of febrile temperature takes place. Decided sweating is coincident with the fall in temperature, and a rigor usually succeeds. It may cause coma, and ordinary apyretic doses have induced great weakness and cardiac failure. Toxic doses in animals cause death by failure of respiration. It is an antiseptic, and is destructive of pathogenic organisms. It is also analgesic, and lessens the sensibility of the sensory nerves.

Thymol, therapeutically, is employed as an antiseptic and antipyretic. It is used as a mouth-wash in dental practice to allay the sensibility of the mucous membrane, when the gums are spongy, to arrest retraction of the gums, as a gargle in faucial troubles. For this purpose a solution varying in strength from 1 to 10 parts in 1,000, or as an ointment in from 1 to 5 per cent, may be employed.

In gastric and intestinal catarrh, thymol acts well to arrest fermentation and stimulate digestion. As an anthelmintic, it has acted favorably, but large doses—from 10 to 30 grains—are necessary to dislodge *ascarides*. It is said to destroy *anchylostoma*, and to prevent or remove the secondary troubles caused by this parasite. For this purpose the dose should be one or two grains several times a day.

As an antipyretic, thymol has been employed in *fevers*, in *pneumonia*, and in inflammatory affections. The large doses—from 10 to 30 grains—required to effect any considerable reduction of temperature, the sweats, chills, and depression of the powers of life which are thereby caused, render its use doubtful, even prohibitory. As thymol exercises a deterrent influence over the microbes of *phthisis* and *diphtheria*, it has been used topically with a certain measure of success. To this end it is used in the form of spray and by inhalation, of the strength of 1 per cent.

Externally, thymol is used in the treatment of parasitic skin diseases, as *tinea* and *pityriasis versicolor*, with success. An ointment of 5 per cent in lanoline or vaseline is suitable for this purpose.

Thymacetin.—Under this name appears a derivative of thymol, corresponding to phenacetin, a derivative of phenol. It occurs in the form of whitish crystals, slightly soluble in water.

Thymacetin possesses properties not unlike phenacetin, its congener. It is analgesic, antipyretic, and antiseptic. By Jolly it has been used successfully in the treatment of *hemicrania* and *congestion of the brain*. It has been beneficial in other kinds of *neuralgia*, and as a hypnotic in *wakefulness*. It will probably prove useful in asthma, whooping-cough, and other nervous affections. The dose ranges from 2 to 10 grains.

Myrtol.—This new antiseptic has the same relative origin as thymol; it is derived from the myrtle, and is an oil, isomeric with the oil of turpentine (?). It is a very active antiseptic (Gubler). It prevents the decomposition of urine and other putrescible animal substances, and has been used to destroy the fetor of decomposing pus. As an active parasiticide it has been used successfully against the *round worm*, and the *ascarides* infesting the rectum. By Laboulbène it has been prescribed for the expulsion of *tænia*, with only partial success.

The parasitic affections of the skin—*favus*, *herpes*, and *pityriasis*—are cured by myrtol.

In moderate doses this agent is rather grateful to the stomach, and is a stomachic tonic or stimulant. The most important application made of it is in the treatment of *bronchorrhœa*, *fetid bronchitis*, *gangrene of the lungs*, etc. Eliminated by the lungs largely, it stimulates the tissues through which it passes, and thus a local action is added to the systemic effect. *Chronic bronchitis*, *capillary bronchitis*, *whooping-cough*, *humid asthma*, etc., are maladies in which it may be expected to afford a large measure of relief. In *hæmaturia* not due to acute congestion, and in *passive hæmorrhages* in general, it has been used with success.

It has long been known that oil of cloves, and indeed the essential oils generally, have the power to relieve a painful state of a sensory nerve. Inserted into the cavity of an aching tooth, they suspend the pain. A solution of oil of cloves in rhigolene is a nostrum for the cure of superficial *neuralgiæ*. ℞ Ol. caryophylli, ol. gaultheriæ, ol. thymii, āā ʒ j; tinct. benzoini, tinct. cinnamomi, āā ℥ iv. M. Sig.: *Apply on lint, and cover with oiled silk.*

The oil of cloves is the most effective deodorizer for sponge-tents hitherto employed.

The essential oils dissolved in alcohol (essence or tincture) are much used to correct *flatulence*.

Cajuput-oil has been used successfully in *cholera*, *cholera-morbus*, and *nervous vomiting*. ℞ Ol. cajuputi, ʒ j; spts. chloroformi, tinct. cinnamomi, āā ℥ j. M. Sig.: *A teaspoonful every half hour in glycerin or sirup and water.* As a parasiticide, cajuput-oil is an effective local application in parasitic skin-diseases—*scabies*, *tinea*, *pityriasis*, etc.—and in the form of enema, in a suitable vehicle, against *ascarides vermiculares*.

Menthol.—A stearopten (having the character of a secondary alcohol) obtained from the official oil of peppermint (from *Mentha piperita*, Smith) or from Japanese or Chinese oil of peppermint (from *Mentha arvensis*, Linné, var. *piperascens*, Holmes, and *Mentha Canadensis*, Linné, var. *glabrata*, Holmes; Nat. Ord. *Labiatæ* [U. S. P.]).

"Colorless, acicular or prismatic crystals, having a strong and pure odor of peppermint, and a warm, aromatic taste, followed by a sensation of cold when air is drawn into the mouth.

"Menthol is only slightly soluble in water, but imparts to the latter its odor and taste. It is freely soluble in alcohol, ether, chloroform, carbon disulphide, or glacial acetic acid. When triturated with about an equal weight of camphor, thymol, or chloral hydrate, it becomes liquid."

Actions and Uses.—The oil of peppermint has long been known to have carminative and anodyne properties in flatulent colic and gastralgia, and in gastric and intestinal catarrh. It has been much used in domestic practice for these purposes. Since the discovery of menthol, a much wider range has been given to its applications. To the taste it is pungent, a little bitter, and the local effect is extended into a cooling sensation when air is drawn in. The sense of coolness is due to an impression on the sensory nerves of the part. Applied to the skin it causes some heat, and the superficial vessels dilate, causing redness. It lowers the sensibility both of the motor and sensory nerves. The circulation is first excited, then depressed by it, and the heart is finally paralyzed.

That menthol allays the sensibility of painful nerves a multitude of facts show. For *hemicrania*, *neuralgia* of the face, and *toothache*, it is a sovereign remedy. To give relief in these cases, the solid stick or cake is rubbed on until the pain is relieved or the skin becomes red and sensitive. An excellent combination for the relief of local neuralgias is a mixture of menthol, thymol, chloral hydrate, rubbed up together until liquefied, and then morphine, atropine, or cocaine, or all, dissolved in the mixture. ℞ Menthol, thymol, chloral hydrat., āā ʒ ij; adde morphinæ sulph., gr. ij ; atropinæ sulph., gr. $\frac{1}{8}$; vel. cocainæ hydrochlor., gr. j. M. Or a solution of the three in ether or chloroform may be painted over a painful or inflamed part. There is little doubt that menthol applied freely may arrest a beginning *boil* or *abscess* in accessible places. To an *inflamed joint* the combination above mentioned is an effective application. This is true of rheumatic or gonorrhœal inflammation. Internally menthol is applicable to the treatment of spasmodic *cough*, *asthma*, and *singultus*. In some instances it has appeared to do good in phthisis.

Teucrin.—Mosetig-Moorhof gave the name *teucrin* to a concentrated, sterilized extract of *Teucrium scordium*—*Extractum teucrii scordii depuratum*—a member of the *Labiatæ*. As it has a source similar to that of thymol, and close relations to the other agents of the group, it is appropriately considered here. Teucrin is administered, chiefly hypodermatically, in the dose of 3 grammes, or 46 grains. It is necessary in practicing the injection to observe every antiseptic precaution—the instrument, the fingers of the operator, and the patient's skin about the site of the injection being antiseptically prepared.

The concentrated extract, or teucrin, is dark brownish in color, of honey-like consistence, pungent in taste, cabbage-like odor, and somewhat acid in reaction. The effects are local and systemic. When a full dose is given an immediate rise in temperature takes place, the mercury reaching to 39° C. or 40° C.=104° Fahr. in the course of a few hours. Slight chills are felt at the onset of the febrile movement. The return to normal takes place in ten to twelve hours. The functions continue undisturbed, the tongue remains clean, the skin moist, and the general sense of well-being unaffected. The local effects consist in some pain, redness, and œdematous swelling at the site of the injection, which last about twenty-four hours.

Besides the fever movement, which occurs in the sick and well alike, teucrin has a peculiar effect about the site of chronic inflammatory deposits: it causes a congestion of the surrounding area, an increase in the leucocytes, and softening, disintegration, and absorption of the pathological material or new formation, or exudation. This occurs usually within twenty-four hours after the injection is practiced, or may extend to two days. Such effects, in brief, are similar in character to those set up by cantharidic acid or the cantharidates when they are employed by the method of Liebreich, or those induced by tuberculin as this was made use of by Koch. The local action is accompanied by fever, rapid pulse, and other evidences of systemic disturbance.

By Mosetig-Moorhof teucrin has been employed with "brilliant" results in the treatment of *cold abscesses*, *fistula*, *sinuses*, etc., of tubercular origin. Two injections at twenty-four hours' interval usually suffice, the dose being 46 grains. It proved useful in fungous *adenitis*. Lymphatic glands, suppurating and tuberculous, were greatly improved and made to heal. Also, good results were obtained in *lupus* and *antinomycosis*.

Besides these applications of the remedy, it has been used successfully in gastric catarrh administered in capsules in the dose of 0·5 grm. = 8 grains.

ANIMAL EXTRACTS.—PTOMAINES AND LEUCOMAINES; TOXINS AND ANTITOXINS.

Ptomaines and Leucomaines.—Peculiar basic compounds have for some time been known to exist in the tissues of animals corresponding to the alkaloids formed in the course of the development of plants. These basic compounds are hence termed *animal alkaloids*. Those are designated *ptomaines* which are produced in the course of pathological processes, and are due to the actions of pathogenic organisms. When the powers of microbes in setting up morbid states was first discovered, these results were ascribed to the immediate action of these bodies, but it has been ascertained that in the course of their growth and development they produce pathogenic substances. Among the numerous ptomaines may be mentioned *indole* and *skatole*, decomposition products to which the odor of fæces is due mainly; *choline* and *neurine*, results of the transformation of lecithin; *tyrotoxicon*, the poison of milk and cheese; *tetanotoxine*, derived from the bacillus of tetanus; *typhotoxine*, from the bacillus of typhoid, etc.

The organic alkaloids with which we are here concerned are produced by certain glands and structures of the body in the course of their normal physiological activity or metabolism. It was not until Brown-Séquard's announcement of the effects of testicular juice that any efforts were made to apply the new principle in practical therapeutics. He ascertained that testicular extract, injected subcutaneously, had an extraordinary power to restore the muscular strength and to increase the mental activity of the aged. Soon after, Paul and Babes suggested the employment of other extracts supposed to contain leucomaines possessed of certain special physiological powers. Some of these have been proved to possess distinct curative power.

Orchitic or Testicular Extract.—It is unnecessary to go into details regarding the effects of ablation of the testes. The changes in the hair and skin, the loss of subcutaneous fat, the alteration of the voice, and the mental peculiarities which develop in time are so well understood that further details are unnecessary. In the present state of our knowledge there can be little doubt that the effects of removal of the testes could be obviated by the persistent administration of a normal testicular extract. There is therefore contained in the testes a leucomaine, or organic principle, of great importance in the growth and development of the body.

The testicular extract now employed is obtained from the testes of the bull. These bodies are carefully selected, cut up into small particles, macerated in glycerin with the addition of salt solution, filtered, and sterilized in a suitable apparatus in which it is exposed to the action of liquid carbonic acid. The liquefied carbonic acid is made use of because it is a strong antiseptic and does not impair the virtues of the albuminoids and soluble ferments. This is the method of D'Arsonval, as carried out under Brown-Séquard's direction. Other modes of preparing the extract are followed, but it must be aseptic, and free from all foreign substances. The dose ranges from ♏ xv to ʒ j, injected subcutaneously.

The composition of testicular fluid is complex. Some of its constituents are to be found in the body generally; some are peculiar to these glands. A crystalline principle, a phosphate called *spermine*, which is contained in it, is held by Poehl to be the active material; but this is not generally admitted. Whatever physiological action the testicular fluid has is due to the albuminoid matters, the leucomaines, and the nucleins which it contains. Brown-Séquard showed in a series of experiments on animals that the fluid increases the power while it lessens the reflex excitability of the nerve-centers. It does not modify the circulation or respiration, but it notably increases the power of the heart when greatly enfeebled by loss of blood. Ataxic symptoms, and paralysis of muscles artificially induced in animals, were made to disappear quickly under its influence. As regards the function of hæmatosis and the general nutrition, it exercises but little influence.

As the first experiences with testicular extract were in respect to its influence over senility, the condition of *senile debility* was the first malady in which it was employed therapeutically. Cases are reported by Brown-Séquard, Vogt, Villeneuve, J. J. Putnam, and Loomis, in which the physical and mental decline of age were notably improved. Of a group of 39 cases of senile debility reported by Brown-Séquard and D'Arsonval only 4 or 5 cases were unimproved. Villeneuve says that the fluid revives the organic energies, rejuvenates the faculties, and so improves the mind that mental activity long dormant becomes possible again. It seems certain that decline in the sexual vigor, when purely functional, is one of the conditions improved, even cured, by this remedy. There is by no means unanimity on this, the least questionable point regarding the utility of the testicular fluid. Thus Fürbringer, in his trials of the various extracts, finds them devoid of therapeutical activity. In a discussion recently before the Berlin Medical Society it seemed to be the consensus of opinion that the animal extracts, including the testicular, were of little or no value, except the thyroid.

Renal and Supra-renal Glands.—The most important of the glandular remedies after the thyroid is the supra-renal. Some favorable reports have been made regarding the utility of preparations of the kidney, in affections of this organ especially, but in respect to well-defined physiological action the suprarenal is much superior. Pellets of the gland, extracts, and its active principle *adrenalin*, have been employed with much success in suitable cases. The gland substance is prescribed in the form of pellets of three to five grains; the extract is much employed topically in affections of the throat and nasal passages and elsewhere, and the adrenalin hydrochloride is also applied to the conjunctiva and to accessible mucous surfaces in the form of a solution having the strength of 1 to 1,000. Whether applied topically or taken internally, characteristic effects follow, chiefly on the vasomotor system, increasing the energy and lessening the number of the heart beats, raising the arterial tension, and thus diminishing the blood supply to a given area. Applied to the mucous membrane, it contracts the vessels, and the surface appears blanched and bloodless.

Thyroid Body.—The most conspicuous example of benefit from the use of an organic substance is that afforded by the thyroid body. Schiff was the first to demonstrate that certain functional derangements and impaired nutrition accompanied by characteristic symptomatology followed removal of the thyroid body. A corresponding state was next observed in man by Reverdin, of Geneva, as a result of the surgical removal of the gland. Kocher, of Berne, next reported a series of cases similar to those of Reverdin, in which the total extirpation of the thyroid caused symptoms very similar to those described by Sir William Gull, and subsequently by Dr. Ord, under the designation of *myxœdema*. The effects observed after removal of the thyroid consist in an affection of the skin and subcutaneous tissue and the mucosa; by changes in the cerebro-spinal functions, and by a remarkable cachectic state. By Kocher this complex of symptoms was called *strumapriva cachexia*. Schiff next demonstrated (1884) the important fact that this pathological condition might be removed and the *status in quo* restored by implantation of a fresh thyroid in the peritoneal cavity. Horsley was the first to suggest to substitute the thyroid of the sheep for relief of myxœdema by the process of grafting. Murray then proposed to effect the same result by injecting an extract of the thyroid prepared with the proper antiseptic precautions. Successful cases were soon reported by Fenwick, Beatty, Whipham, Corkhill, and others, of England; by Mendel, Wichmann, and others, of Germany; by Robin, Chopinet Chantemesse, and others, of France. The next most important step was the use of the gland itself, proposed by Dr. Howitz, professor in Copenhagen. At first this process consisted in feeding the raw gland in various forms to the subjects of myxœdema, but at the present time liquid extracts, the gland in powder, or compressed into tabloids, are employed, and with much success.

Various disturbances have ensued when too large quantity of the thyroid has been given. It is rare, however, that the actions are such as to compel its entire withdrawal. Among the symptoms caused by too free administration of the gland are the following: Headache, dizziness, numbness and tingling of the extremities, insomnia, a sense of fatigue, loss of appetite, wasting, urticaria, erythema and itching of the skin, rapid action of the heart, and sudden feebleness. By simply suspending its use for the time being, or by giving a diminished quantity, the ill effects will disappear.

As regards the quantity of thyroid to be given, the dose varies according to age and susceptibility. From one half to one gland a day, equivalent to a half to a teaspoonful of the extract, or one to three tabloids made of the desiccated substance three times a day, will procure the desired therapeutical effects.

The malady for which the thyroid is administered with entire success is *myxœdema*. The morbid complex constituting this peculiar disease is gradually removed, and, so long as the gland is made use of, does not reappear. It is now known, however, that occasional administration of the remedy is necessary to maintain the health at the normal standard. The influence of the thyroid is essential, and if, in consequence of its atrophy, that influence is withdrawn, obviously it must be supplied from without. Sufficient time has not yet elapsed to determine how long and to what extent the supplementary gland must be employed.

Obesity is another malady in which the thyroid has been used with success. It is almost the only remedy for this condition acting in a direct manner. It has the power to reduce the body-weight without any modification of diet or change in the manner of living. It must be given with caution, that the loss of flesh may not proceed too rapidly, and that cardiac depression may be avoided.

In *exophthalmic goitre* excellent results have been obtained by the use of the thyroid. The author has seen great improvement in cases of extreme difficulty. Some instances of *goitre* have been apparently cured, as reported by Ingalls and Metzgar, in this country.

Iodothyrine is an extract from the thyroid, rich in iodine, and is claimed to be an active principle, which is permanent in form and composition. Besides its utility in affections of the thyroid it has been successfully employed in the treatment of psoriasis and eczema. That it will take the place of the thyroid gland is more than doubtful. Indeed, to give iodothyrine most efficiently, it were better to feed the patient on the fresh gland itself. Undoubtedly, the best results have been had in this way. At the present time the thyroid tablet should represent the gland in its purity.

Extract of Bone Marrow.—The red marrow of bones, especially of the ribs, has been utilized in medical practice. The marrow itself, finely subdivided and seasoned suitably, has been eaten spread on buttered bread. For the most part the glycerin extract is used, and is so prepared as to be given in the dose of a teaspoonful three times a day.

As the red globules of the blood are to a great extent developed from the large cells of the red marrow, it follows that the administration of this material should increase them when deficient. It is especially in *anæmia* characterized by deficiency in the red blood-globules that the use of bone marrow is indicated, and the clinical experience coincides with theory, for a remarkable improvement takes place in cases of this kind. The results of its administration are these: the red globules and the hæmoglobin are increased, and the white cells are lessened. These good effects are accompanied by a general improvement in body weight and an increase of vital activity in all directions.

Toxins and Antitoxins.—Besides those basic compounds known as leucomaines and ptomaines, certain toxic albuminous substances (*toxalbumins*) are found already formed, or are artificially created. They are now usually called *toxins*, because possessed of active toxic properties. Of those formed in the course of the physiological activity of organs are the various snake-poisons, and *abrin*, from the *abrus precatorius*, commonly known as "jequirety," and *ricin*, from the castor-oil bean (*Ricinus communis*). Besides the toxalbumins, or toxins, there are also formed principles that protect the organism against the effects of toxins, and are hence known as antitoxins. Toxins are the products of bacterial actions. Among the more familiar are the *anthrax protein* produced by the anthrax bacillus, *toxopeptone* and *toxoglobulin* produced by the cholera bacillus, and toxomucin (tuberculin) produced by the tubercle bacillus. Some organisms are provided with an albuminous substance which has the power to destroy pathogenic bacilli, or to antagonize the toxin which they form. The condition of exemption thus created is known as *immunity*. It is now believed that pathogenic bacteria produce each a poison peculiar to itself, and an albuminous substance which, if injected into the tissues of another animal, protects it against the action of the poison. An animal thus protected is said to be *immune*, and if the blood-serum of such immunized animal is injected into the system of another animal, this also becomes immune.

We owe especially to Behring, of Berlin, and Roux, of Paris, the demonstration of the methods by which immunization and the formation of antitoxins are produced. Taking the diphtheria toxin and antitoxin as models, we find that the first step consists in the formation of an active toxin by cultivation of the germs in an artificial medium. From a number of such cultures a specially virulent one is selected. The activity of this toxin is ascertained by injecting it into guinea pigs. If it is ascertained to have sufficient virulence or toxic power, it is then used to secure the immunization of the horse, which is found to be the most suitable animal for the purpose. As there are great differences among horses in regard to their susceptibility to the effects of the toxin, a small dose is first employed. Beginning with ½ c. c., the strength of the injection is rapidly increased until it reaches 200 to 250 c. c. The injection is practiced once in eight days, and consequently three or four months are occupied in producing immunization, so that at length as much as 250 c. c. can be injected without producing any reaction. The result is, the injection of toxins develops antitoxin in the blood-serum of the horse. To procure the antitoxin in a form available for administration, the blood is drawn off under suitable precautions, and the serum is separated from it by a process of aseptic filtration. Patience in the whole proceeding, care at every step, and minute attention to the horse's health, are necessary to secure the best result. The physician should only make use of serum that has been carefully tested and that conforms to the highest standard.

The foregoing remarks on the immunization of the horse are based on the administration of the toxin by subcutaneous injection. If, however, the toxin is injected directly into the horse's veins, and the process of immunization is conducted over a longer period of time, the resulting product will have considerably greater power. The strength of antitoxin solutions must, it was early seen, be expressed in terms of a uniform standard that may be universally conformed to. A *unit* being agreed upon, the other terms of the scale follow—that is, an *immunity unit* in which the amount of antitoxin serum sufficient to save from fatal results a guinea pig weighing 500 grammes, to which the minimum fatal dose of diphtheria toxin has been given. Ten times more is required for the human subject than for the guinea pig, is a close estimate.

The first therapeutical employment of antitoxin in disease was by Behring, soon followed by the clinical observations of Roux. Behring ascertained that active cultures of the bacillus of diphtheria were rendered inactive by mixing them with the blood-serum of immunized animals. The serum was then used as a vaccine to prevent the poison of diphtheria (toxin) developing in susceptible subjects, and to neutralize or inhibit it when the disease was in process of evolution. Roux carried out the same method at Paris with equally promising results, and at the present time this plan of preventing diphtheria or of arresting it has been taken up in all civilized countries.

The units of strength of any preparation of serum should be known before making use of it. The quantity injected varies from $\frac{1}{1000}$ to $\frac{1}{100}$ of the body weight, the latter rarely. About 20 c. c. is probably the average of the various serums in the market. The frequency of the injection varies with the severity of the case, and is once or twice in the twenty-four hours. Some redness, and not unfrequently erythematous rashes and urticaria, appear near the site of the injection. If suitable antiseptic precautions are observed, nodules followed by suppuration can hardly occur. The earlier the serum is injected the more favorable the result. It can hardly be expected that cases of many days' standing, with extension of the local process to the larynx, and with general diffusion of the poison, will prove as amenable to the action of the antitoxin as recent examples of the disease; but it has happened. Some cases of the worst type have been most favorably acted on. The injection of antitoxin when it acts well reduces temperature, abates dyspnœa, and favors detachment and expulsion of the false membrane.

Tetanus is now known to be produced by a special bacillus. Cultures of the bacillus by the method of Behring develops in animals by repeated injection a state of immunity, and immunized animals furnish a blood-serum containing the antitoxin. When the serum is added to the poison the latter loses its activity and is harmless. Many successful cases of tetanus treated by the antitoxin have been published. When a sufficient quantity of the serum of immunized animals has been injected, the severity of the disease is lessened, the spasms become less frequent, the temperature falls, sleep occurs, the general state improves, and the duration of the disease is shortened.

Pneumonia is one of the specific maladies which has been subjected to the action of an antitoxin. Animals are rendered immune by repeated injections of cultures of the pneumococcus, and the serum of immunized animals was found to be effective against pneumonia. These experiments proved so successful that Neisser and Klemperer then proceeded to make use of the serum of human subjects convalescent from pneumonia. In accordance with the principles already enunciated, it was supposed that an attack of pneumonia developed the antitoxin in the blood-serum of the individual affected. In the trials in pneumonia that have been made, it was found that the antitoxin serum lessened the violence of the disease, the crisis occurred early, and with the decline in temperature to the normal there ensued a corresponding abatement in the physical signs. The trials that have been made in this country, if not altogether favorable, have at least given promise of future success when all the conditions are properly complied with.

The treatment of hydrophobia by antitoxins is associated with the name of Pasteur. Although his theory is not accepted by all, and his results are questioned, there can be little doubt that his method of vaccine has greatly modified the usual course and termination of that disease. The real place which this mode of treatment shall take in the therapeutical processes of the future can not now be stated. It must be regarded as still *subjudice*, with the preponderance of authority in favor of the method. On a candid survey of the whole field, the author is constrained to say, however, that the practical outcome is short of the success which seemed to him warranted by the pretensions put forward by its original promoters.

Authorities referred to :

BRA, DR. M. *La Thèrapeutique des Tissues ; Compendium des Médications par les Extraits d'Organs Animaux.* Paris, J. Rothschild, 1895, pp. 624.

[To mention the numerous papers and works on the subject would occupy too much space. The work named is the most recent and elaborate on the subject.]

AGENTS USED TO MODIFY THE FUNCTIONS OF ORGANS.

A. OF THE NERVOUS SYSTEM.

IN this division, remedies are employed with a view to their influence over the functions of the nervous system. They do not immediately or necessarily affect the function of nutrition ; they do not enter into the formation of tissues ; and, having modified the functions of the nervous system, they are excreted from the organism in the form in which they entered it. It is probable that the selective action on this system is due to the fact that the nervous tissue is the most highly specialized in function, and therefore most susceptible to such impressions.

The different parts of the nervous system are so closely united in function that a disturbance at any point is differentiated to other and often widely-separated points, and the complexus of effects is made up of many minor disturbances. For this reason it is quite impossible, in the present state of our knowledge, to make a classification which will sharply define the limits of activity of any particular remedy. Nevertheless, physiological experiment and clinical experience have furnished us sufficiently accurate information with regard to the most important actions of the remedies of this division, to justify an arrangement based on their most conspicuous qualities.

THOSE EXCITING THE FUNCTIONAL ACTIVITY OF THE SPINAL CORD AND SYMPATHETIC.

Electricity.—*Electricité*, Fr.; *Electricität*, Ger.

Forms of Electrical Force employed in Medical Practice.—Magnetism, static or frictional electricity (franklinism), galvanism, faradism (electro-magnetic, magneto-electric).

STATIC OR FRICTIONAL ELECTRICITY.

This is obtained by friction from glass, as in the cylinder or plate, and by induction from the Holtz electrical machine. The last-named instrument is best adapted for medical use. The prime conductor of the electrical machine furnishes positive or vitreous electricity, and the rubber, negative or resinous. Various modes of electrization by static electricity are resorted to:

1. By sparks. In this mode the part to be acted on is made to receive sparks from the machine in action.

2. The electric bath. The patient is placed on an insulated stool, and is charged with positive or negative electricity from the prime conductor, or rubber, according as he is in connection with either. Sparks may be drawn from the affected part by presenting the knuckles or a metallic conductor. A sharp, tingling sensation, followed by redness and wheals, is produced by sparks, whether received from the machine or drawn from the body.

3. By the Leyden-jar. In this method, the electricity is condensed in the Leyden-jar, and the charge is transmitted through the part to be acted on.

Owing chiefly to the physicians of Guy's Hospital, London, and Dr. Charcot and his pupils, Dr. Arthius and Dr. Vigouroux, of Paris, the use of static electricity as a therapeutical agent has been revived and rendered entirely practicable. Dr. Morton, of New York, and the author, simultaneously arrived at a method of using the Holtz electrical machine as a means of stimulating muscular contractions, and as a substitute for the faradic current in cases requiring such treatment. Before describing these manipulations it is necessary to say something regarding the structure of the Holtz machine. Various modifications of the original pattern have been introduced; but the most successful is that of Toepler. There are, however, several excellent machines adapted from the Holtz model to suit the views of mechanical theorists or practical electricians, which may be employed with entire confidence. The author has used with satisfaction a machine the revolving plate of which has a diameter of fourteen inches and the fixed plate of sixteen inches. The power may be furnished by an electric motor, by a water motor or more conveniently by an assistant. In the annexed figure, the arrangement of the Toepler-Holtz is shown. This is the model which the author uses, and is found to be sufficiently powerful for medical purposes. During the winter, when the consultation-room is kept at or about 70° Fahr. by artificial heat, this instrument works with entire satisfaction. In the late spring and summer, for the most part, the atmospherical conditions are such that some means are necessary to preserve the instrument from moisture. This is accomplished by inclosing the machine in a suitable glass case and keeping within it some chloride of calcium to absorb the moisture. An arrangement of this kind is preferred by Dr. Morton, of New York, who uses the original Holtz machine.

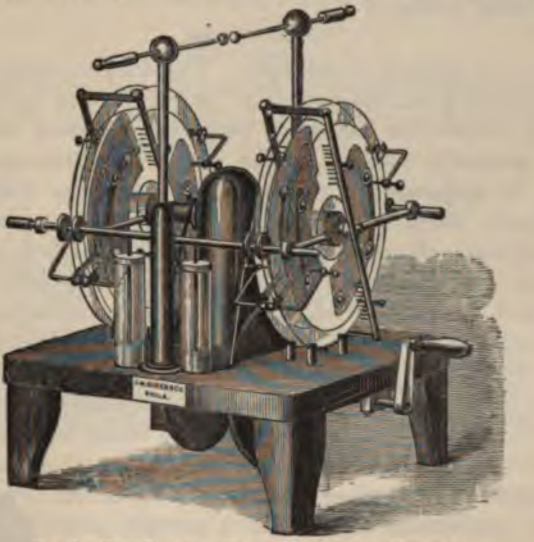

FIG. 1.—THE TOEPLER-HOLTZ ELECTRICAL MACHINE.

The Holtz machine may also be employed to procure the muscular effects, hitherto obtained only from faradic appliances. The current passing between the discharging-rods can be tapped by means of a flexible wire attached to the outer coating of one condenser, and another flexible wire connected with the brass knob or bar which is in communication with the interior of the other condenser. The strength of the current and the rapidity of the interruptions are regulated by the distance between the knobs of the discharging-rods. At every passage of a spark a muscular action takes place. If the knobs are placed very near each other, so rapidly do the sparks pass, that the effect produced is very like that obtained from a mild faradic current. Thus, by an arrangement of the machine which can be done on the instant, the actions, heretofore only obtainable from the faradic machines, are readily procured from the statical electrical instrument. Besides the effectiveness of this method, it has the advantage that it is almost painless. In no other way can strong muscular contractions be induced with so little pain, at least.

MAGNETISM.

Magnets are natural or artificial. The former consist of a native iron-ore possessed of the magnetic property; the latter are pieces of steel in which the magnetic property has been induced. This magnetic property consists in the power to attract pieces of iron and steel, in maintaining a certain fixed position when suspended to move freely, and in attracting or repelling the extremities of other similar magnets. A magnet suspended, free to move, always points in a certain direction, north and south. That end pointing north is the "marked" extremity, because it has a mark, notch, or groove, or the letter *N*, to indicate it. Because of this property, the magnet is said to have "poles," or polarity. The poles behave toward each other in a certain definite way: *Unlike poles attract; like poles repel*, is the law. When a bar-magnet is made to approach a magnetic needle moving on a pivot or suspended, there ensues attraction or repulsion, according to the polarity of the extremities approximated. When a certain proximity is attained, yet some distance short of actual contact, the magnetic influence is exerted, and attraction or repulsion, according to the pole, takes place. If a bar of soft iron, not magnetized, is suspended, on the approach of a permanent magnet, the former is seen to move toward the latter when they are approximated. The magnetic force is thus exerted through an intervening space: *inversely as the square of the distance*, is the law, which expresses this action in mathematical form. To this property is applied the term *magnetic induction*. When the soft iron is acted on by a sufficiently powerful magnet, it ceases to be in a neutral or unexcited state, the magnetic property is *induced* in it, and for the time being it assumes the polar condition; but not possessing the *coercitive* property—i. e., the property to retain the magnetism induced in it—soon returns to its former neutral condition. Steel, having the coercitive property, is the material out of which permanent magnets are made. The magnetic prop-

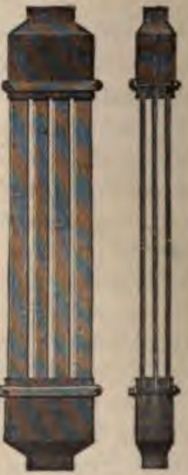

FIG. 2.—COMPOUND MAGNET.

erty is induced in such pieces of steel by the contact of other permanent magnets. When once induced, the magnetic property may be readily destroyed by a powerful blow, by repeated scratching, and by heating.

When a magnet is broken into several fragments, each piece has the same polarity. The forms of magnets are the bar and horseshoe, chiefly—the latter being more convenient, and also better retaining its power, because an armature can be kept in position. A compound horseshoe magnet is usually preferred for medical use, because of the proximity of the poles, but the straight form (Fig. 2) is also used.

GALVANISM.

All chemical action is accompanied by electrical phenomena. The electricity furnished by the galvanic combinations in use is derived from a chemical action which takes place in the elements. These are of various forms. Reduced to its simplest condition, a galvanic combination consists of two substances, one of which can be acted on chemically, while the other has merely the conducting property; and also of a material—a fluid, usually—which can excite the chemical action. There is, then, a generating plate or element, usually of zinc, a conducting plate or element of copper or carbon, usually, and a fluid or semi-solid which acts on the zinc, setting up the chemical action. When such elements with the exciting fluid are placed in a glass or earthen vessel, the whole combination is called a *galvanic cell* or *couplet*, and when several of these are united they form a *battery* (Fig. 3).

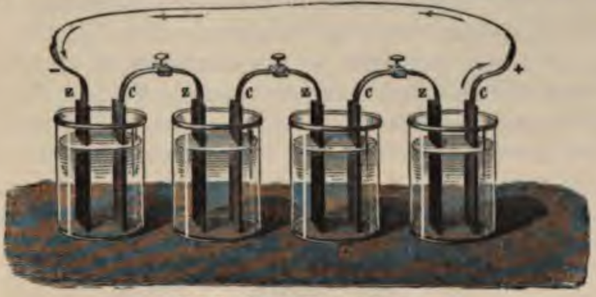

FIG. 3.—GALVANIC BATTERY.

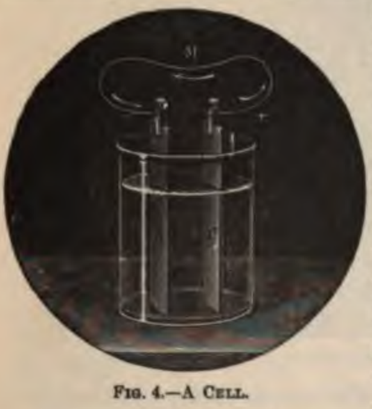

FIG. 4.—A CELL.

Galvanic cells may have a single or two fluids: the single fluid is not constant; in the two-fluid, there are arrangements, partly mechanical, chiefly chemical, for securing constancy in the current. In Fig. 4

we have two metals—zinc, *z*, and copper, *c*—united by the wire, *M*, placed in a glass vessel containing dilute sulphuric acid. The chemical action in such a cell consists in the formation of the sulphate of zinc, the water being decomposed, and hydrogen appearing at the surface of the copper. Such an arrangement may be defined to be a means of making a difference in potential between two points. Electricity flows from the higher to the lower potential. The point where the chemical action is taking place—the surface of the zinc—is the higher potential, and hence "the current" passes from this through the liquid to the lower potential, the copper, which is the conducting plate. Now, as the current always flows from the higher to the lower potential, it follows that, outside of the element, the copper becomes positive and the zinc negative, for the current passes through the "conjunctive wire" from the former element to the latter. It follows that such an "element," or "cup," can not furnish a *constant* current. The chemical action soon rises to the maximum, the sulphuric acid combines with the zinc, and hence the exciting fluid is soon nothing more than a saturated solution of zinc sulphate, while the hydrogen accumulates on the copper plate. The chemical action, therefore, quickly subsides, and the hydrogen-bubbles hinder the passage of the current by the conducting plate. Elements of this kind are usually employed to run faradic machines, but they are not suited for galvanic batteries, since the tension of the current varies so much in a short time, and the action soon ceases.

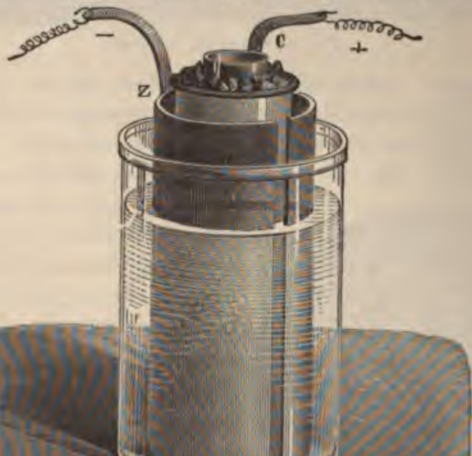

FIG. 5.—DANIELL'S ELEMENT.

The two-fluid cells, in which the chemical action is less violent, and mechanical devices prevent the polarization of the hydrogen, are alone suited to medical uses. Only those ascertained by experience to be adapted to medical purposes can be referred to. One of the earliest two-fluid cell batteries constructed was that of Daniell (Fig. 5). The arrangement of the parts in this cell will illustrate the principles concerned in such galvanic combinations. The zinc and copper elements and the two liquids are separated by a porous cup of unglazed earthenware. The zinc, *z*, is outside, and is a cylinder having a cleft; about it is diluted sulphuric acid (1 part to 16 of water). The copper, *c*, is contained in the porous cup, and is surrounded by a saturated solution of copper sulphate, which is kept at the point of saturation by a quantity of the crystals packed around the copper element. The polarization of the hydrogen is prevented by chemical means, for in the decomposition of copper sulphate the hydrogen combines with oxygen to form water, while metallic copper is deposited on the copper element. The Daniell, as modified by the celebrated Dr. Remak, of Berlin, has been more widely used for medical purposes than any other cell, and still maintains its superiority. In this arrangement made by Siemens and Halske, of Berlin, and known under their name, besides the porous cup, a quantity of *papier-maché*, or paper-pulp, is packed in between the elements, and, while the copper is surrounded by copper sulphate in solution, only water is used with the zinc. In the decomposition, copper is deposited on the copper element and sulphuric acid diffuses through into the zinc compartment. This cup is remarkable for the uniform tension of the current, for constancy, and for economy. A "gravity battery," composed of zinc and copper elements,

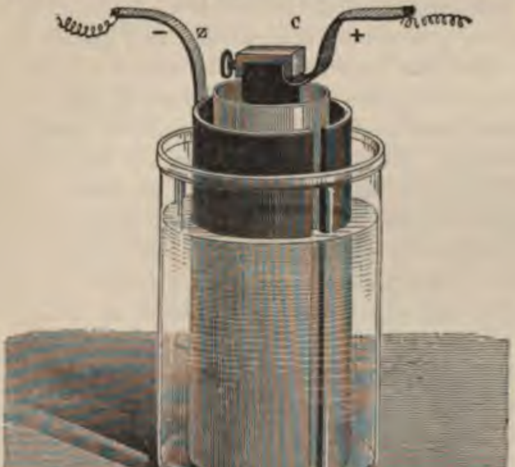

FIG. 6.—BUNSEN CELL.

zinc sulphate solution about the zinc, and copper sulphate solution about the copper, and separated merely by the specific gravity of the respective solutions, is now much employed in telegraphy, and to a considerable extent in medical practice. Zinc and carbon are now utilized in two-fluid as in one-fluid cells. The Bunsen combination is a most efficient one (Figs. 6 and 7). The outer zinc plate has a cleft, and is immersed in dilute sulphuric acid, while the carbon, of the variety known as gas-carbon, is contained in a porous cup with strong nitric acid. Here the hydrogen is intercepted by the nitric acid, nitrous-acid fumes are given off, and sulphate of zinc is formed. It is a very powerful combination, but the fumes of nitrous acid make it very objectionable. Although it is not suited for medical use in general, it is well adapted for galvano-caustic purposes. Mr. De la Rue's chloride-of-silver battery is admirably well arranged for forming a portable or permanent combination for the medical electrician. It may be made of test-tubes, closed with a rubber stopper containing two orifices for the elements, which consist of a zinc rod and flattened silver wire. At the bottom of the tube is placed some chloride of silver, and above this a solution of common salt. The silver element dips down into the chloride of silver, and above this is insulated by sheet gutta-percha. This cell has an electro-motive force a little more than the Daniell, and it is remarkably constant, portable, and unchangeable. A very efficient and at the same time economical cell can be constructed of a tin can, iron filings, a porous cup, and a rod of zinc. In the porous cup, about the rod of zinc, is put some common potash, and the iron fillings which form the positive element are packed around the porous cup.

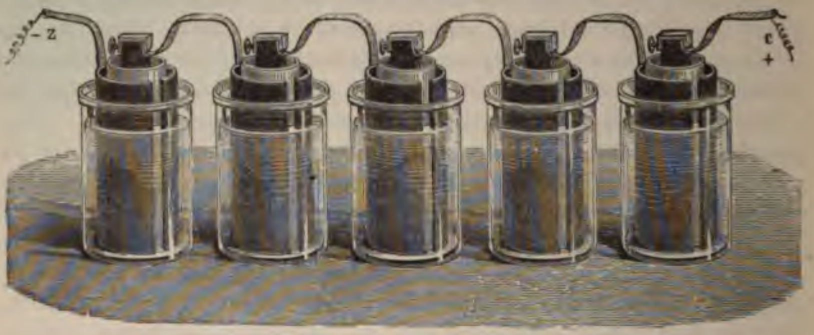

FIG. 7.—BUNSEN BATTERY.

Besides the above, mention should be made of the two-fluid bichromate of potash cell. A solution of the bichromate in dilute sulphuric acid is now chiefly used as the exciting fluid in single-fluid cells ; but, in the two-fluid arrangement, the carbon element is placed in a porous cell containing a saturated solution of bichromate of potash in water only, and the zinc element is acted on by very dilute sulphuric acid (1 to 20). The performance of this cell is in a high degree satisfactory. The carbon in this, as in the other galvanic cells, is gas-carbon, which is remarkable for its density and for conducting power. The zinc is ordinary commercial zinc, amalgamated. The process of amalgamation consists in first immersing the zinc plate or rod in dilute sulphuric acid to make a clean surface, and then rubbing it with a little mercury until it presents a silvery whiteness. A homogeneous surface is thus made, and the loss of power due to the formation of innumerable couplets of zinc with the impurities contained in it is thereby prevented.

The force generated in the cup by the chemical action is termed *electro-motive force*, and it is the difference in potential between the two elements. The power of any combination of cups is the sum of the electro-motive force of each one less the difference caused by resistance in the circuit. The current from a battery has *strength, tension*, and *quantity*. The strength is the amount transmitted in the unit of time, along a given conductor; tension is the power to overcome resistance; and volume is the net quantity available. There are various objects which offer resistance to the passage of the current. The *circuit* of a galvanic battery consists of the space between the elements in the cup, the conducting element, and the wire which unites the poles—the conjunctive wire. The current passing over this circuit has to overcome the resistance opposed by these several parts. The conjunctive wire offers a degree of resistance determined by its length and section. A single large cup, having zinc and carbon elements of corresponding size, excited by bichromate solution, will heat to redness, even volatilize a platinum wire, while twenty small medical-battery cups connected in series will scarcely warm such a wire. Intensity, resistance, and quantity, are now given a mathematical mode of expression. The unit of electro-motive force is the *volt*, in honor of Volta, and is very nearly the power of a Daniell cell, which is, hence, convenient as a standard of comparison. The unit of resistance is the *ohm*, so named from the discoverer of the celebrated law. The unit of intensity is the *ampère*, formerly the weber, both the names of physicists, distinguished in electrical science. An ampère represents the quantity of electricity produced by the unit of electro-motive force —the volt—circulating in a conductor having the unit of resistance—the ohm—during the unit of time—the second. It has been practically ascertained that this is the quantity of electricity furnished by a Daniell cell, and made to pass through a hundred metres of telegraph-wire. The unit of capacity is the *farad*, from Faraday; but, as this amount is much too large for medical purposes, it is the usual practice to employ the term *microfarad*, which is equal to one millionth part of a farad.

There are several modes of ascertaining the current strength. The *voltameter* (Fig. 8) is an instrument for collecting the oxygen and hydrogen produced by the decomposition of water. The quantity of gas per minute evolved by the galvanic action is an absolute measure of the strength of the current during that time. This instrument, although not so much used as the galvanometer for determining current strength, is not without practical utility, and it is employed by Ciniselli and others to ascertain the power of any given combination before proceeding in the operation of electrolysis in the treatment of aneurism. Galvanometers are more frequently used. A galvanic current made to traverse a wire, in the vicinity of a magnetic needle, deflection takes place according to the strength and direction of the current. This constitutes the simplest form of the galvanometer. It is really a *galvanoscope*, indicating the existence of a current and its direction, but not affording an exact measure of its strength. The *astatic* combination is much more sensitive : it consists of two needles of about the same strength, but placed in opposite positions as to polarity, so that the directive force of the earth's magnetism is neutralized (Fig. 9). The arrangement of an astatic galvanometer is shown in Fig. 10. To render such a galvanometer of use as a means of exactly representing the strength of the current, the scale must be graduated in mille-ampères of absolute measurement, or millewebers. Such instruments, as now made, enable the operator to express in exact terms the current

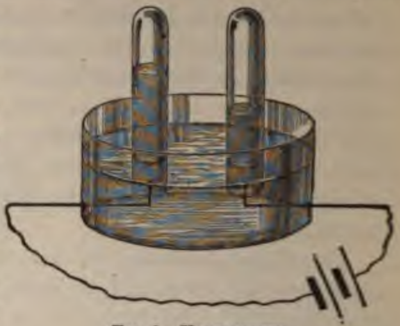
FIG. 8.—VOLTAMETER.

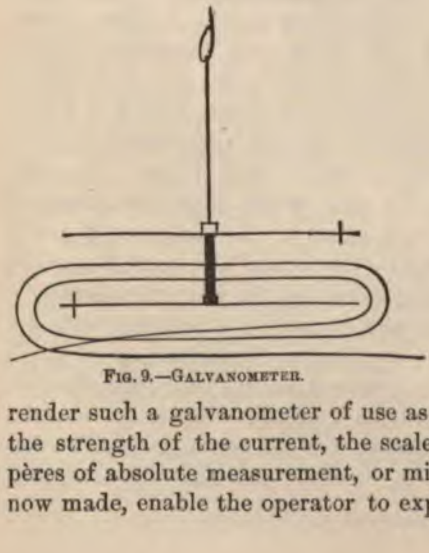
FIG. 9.—GALVANOMETER.

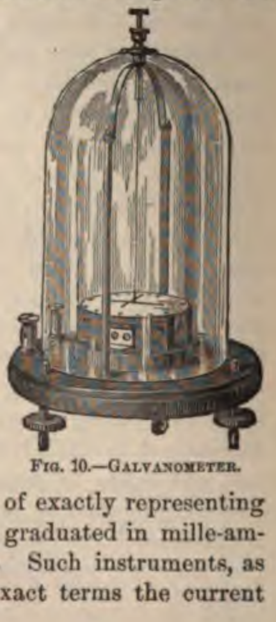
FIG. 10.—GALVANOMETER.

strength ; instead of the number of cups, which affords so inexact a measure, the absolute galvanometer interpolated in the circuit, indicates in mille-ampères, or millewebers, the actual strength. In the present condition of this subject, it has become necessary to express in an exact way the current strength, just as medicines are carefully weighed.

The mode of combining the cells of a galvanic battery is determined by the purpose to which it is to be applied. The circuit may be "simple" or "compound." In the former, the elements are united zinc to zinc and copper to copper, so that in a battery of twenty cells so united there is one large zinc and one large copper element, and the resistance is at the minimum, the chemical action yielding a very considerable quantity of electricity, the most of which is available. In the compound circuit the battery elements are arranged in series, the zinc of one connected with the copper or carbon of the next, and so on throughout the whole number. As every conductor opposes some resistance to the passage of the current—in other words, there is no perfect conductor—there must be considerable loss of electricity. It is sometimes said that the *quantity* of electricity is determined by the size of the zinc plates acted on, and that *intensity* is the result of combining numbers of elements. It must be understood that intensity is the power to overcome resistance, and as the resistance offered by the human body is enormous, it follows that a battery for the medical application of galvanism must have numbers rather than size. Those battery-cells furnish the smoothest current in which the internal resistance is about equal to the resistance of the human body. The zinc-carbon elements of Stöhrer cause considerable irritation and burning, while those of Siemens and Halske are smooth and bland. The most experienced electricians use the latter for this reason. It follows, therefore, that all those devices intended to diminish internal resistance are not to be commended in galvanic batteries for medical use, how desirable soever they may be in batteries for economic purposes. In galvanic batteries intended for transportation, every consideration, except efficiency, must be sacrificed to portability, and various mechanical arrangements have been made to combine these qualities. In the Stöhrer, Gaiffe, and chloride-of-silver batteries, the safe transportation of the cells is insured, but the current of such combinations is wanting in the uniformity and smoothness which are such important qualities in the permanent batteries.

The performance of any galvanic combination may be readily ascertained by the law of Ohm. The intensity is directly proportional to the electro-motive force, and inversely proportional to the resistance encountered within the cell and on the circuit. This law is represented in the following formula :

$$I = \frac{E}{R + r}$$

I is the symbol for intensity, E for electro-motive force, R for internal resistance (in the cup), and r for external resistance (on the circuit). Or it may be stated that $R = \frac{E}{C}$; that is to say, the resistance equals the electro-motive force divided by the current. The term electro-motive force merely means the difference in potential between the two poles.

A battery, whether portable or permanent, requires a "pole-board" for its working. An ordinary battery of a few elements may be manipulated by a simple sliding selector and polarity changer, such as that now attached to the Stöhrer portable arrangement; but the permanent batteries of large size, such as are now employed for the office and consultation rooms of medical electricians, require more efficient arrangements. The battery of 60 to 100 elements placed in the cellar or some distant closet, is connected, in groups of cells, with the *pole-board.* By means of the selector, any desired number of cells can be put in the circuit. The pole-board should also be supplied with a current-changer, a rheostat, an interrupter, and resistance-coils. A water rheostat suffices for ordinary purposes. As water is an indifferent conductor, it follows that the galvanic current has a degree of difficulty in passing through it; hence, any amount of resistance can be interpolated in the circuit. The most accurate mode of introducing a measurable resistance is the *resistance*-coil. This is made of German-silver wire of a certain length and cross-section. The resistance offered by such a wire to the passage of the current is directly as its length, and inversely as its sectional area; that is, the longer the wire, and the less its size, the more the resistance to the transmission of the current. The unit of resistance, the ohm, is the resistance made to one volt by a wire two hundred metres in length. It is obvious that any number of ohms in resistance can be interpolated in the circuit. Resistance-coils of definite measures of resistance are now added to each properly equipped pole-board. They are especially necessary in applications of galvanism by the *polar method.*

FARADISM, OR ELECTRO-MAGNETISM AND MAGNETO-ELECTRICITY.

Faradism, so named in honor of Faraday, is *induced* electricity. When the galvanic current passes through the conjunctive wire of the elements of a cup, especially of a battery, it acquires new properties—acts on a magnetic needle, and exhibits the other properties of a magnet. When the conjunctive wire is extended into a coil, coated with insulating material, it will act on another coil in its neighborhood, as it does on a magnet. The former is called the primary or inducing coil, and the latter the secondary or induction coil. If the latter is connected with a galvanometer, it will be found that when a current traverses the primary coil, the needle of the galvanometer is at once deflected; but if the current continue to pass without any variations in the tension, the needle presently comes to rest. When the current is broken or interrupted, the needle is again deflected, but this time in the opposite direction. It follows, therefore, that the induced current only occurs at the opening and closing of the primary circuit: at the making or closing the circuit, in the opposite direction; and at the opening or breaking of the circuit, in the same direction. The induced or faradic current is therefore a to-and-fro current, instantaneous in duration. It is obvious from these considerations that in the construction of a faradic battery there must be a mechanical arrangement for interrupting the current in the primary circuit. The usual automatic interrupter is Neef's hammer, a vibratile steel spring worked by the magnetism of the soft-iron core. The best instruments are now provided with a simple mechanism to give slow interruptions, an important matter when muscles are to be exercised. In the purchase of a faradic instrument for medical purposes the device to effect the slow interruptions should not be overlooked.

The galvanic couplet for the primary coil is now almost always the zinc-carbon combination excited by bichromate solution.* The primary or inducing coil is made of thick wire and is much shorter than the secondary coil. In the interior of the primary coil is placed a bundle of wires, each one insulated and becoming a magnet when the current passes. This temporary magnet attracts the hammer of the vibrator, and on the instant the current is closed and opened again. The so-called primary current of the faradic battery is therefore some-

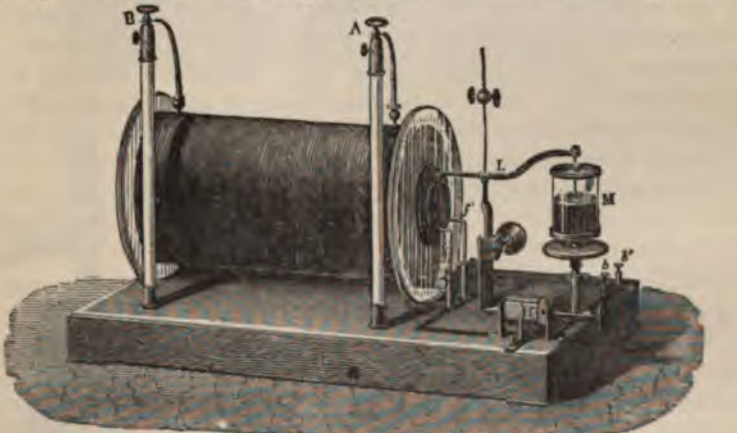

Fig. 11.—Ruhmkorff Coil.

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* The bichromate solution is prepared as follows: Dissolve one ounce of bichromate of potassium in eighteen ounces of hot water in an earthenware vessel. Let it cool, *and when cold* add two fluid ounces of sulphuric acid, and two drachms of nitric acid. It should not be used until cold, and it is, therefore, preferable to keep it on hand.

thing more than that coming from the galvanic couplet; it is reenforced by the induction between the turns of the coil and by the magnetism of the soft-iron core.

The coil of induction, or the secondary coil, is made of long and fine wire; the longer and finer, the more intense the current. The Ruhmkorff coil, which is composed of miles of very fine wire, furnishes a brilliant spark sometimes several inches in length (Fig. 11).

Electro-magnetism is the title of that mode of the force induced by the action of a galvanic current on a bundle of wires within an insulated coil; in other words, it is the ordinary faradic battery, excited by a galvanic couplet (Fig. 12). *Magneto-electricity*, on the other hand, is that mode of the force induced by the action of a permanent magnet. If we substitute for the cell a strong permanent magnet, we learn that, on the approach or withdrawal of the magnet from a coil of insulated wire, a current of electricity is induced in the coil: on the approach of the magnet, in one direction; on its withdrawal, in the opposite direction (Fig. 13). Thus an instantaneous to-and-fro current may be caused by the action of a magnet, just as by the action of a galvanic current. Out of this principle has developed the magneto-electric machine, which consists of the permanent magnets, insulated coils made to revolve about the poles, and a mechanical arrangement for obtaining regular revolutions, and making and breaking the circuit. Thus, by mechanical power, the same results are produced as by chemical action (Fig. 14).

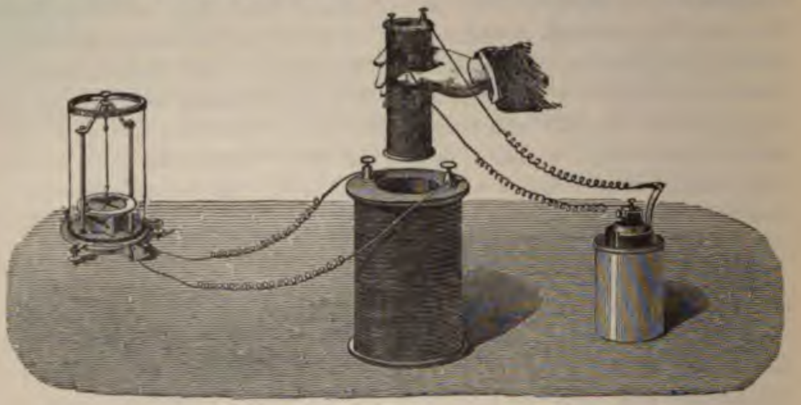
FIG. 12.

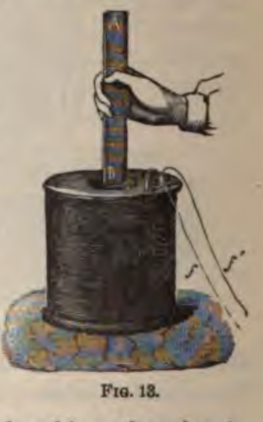
FIG. 13.

The discovery of a simple commutator, by which the currents can be collected and sent in one direction, has quite revolutionized the utility of this form of battery. It is now applicable to electric decomposition (electrolysis), to electric heating (galvano-causty), and electric lighting. Indeed, with the general use of electricity furnished by the "dynamo-machines" as a motive power, it is probable that the force in this form will be successfully applied to medical purposes.

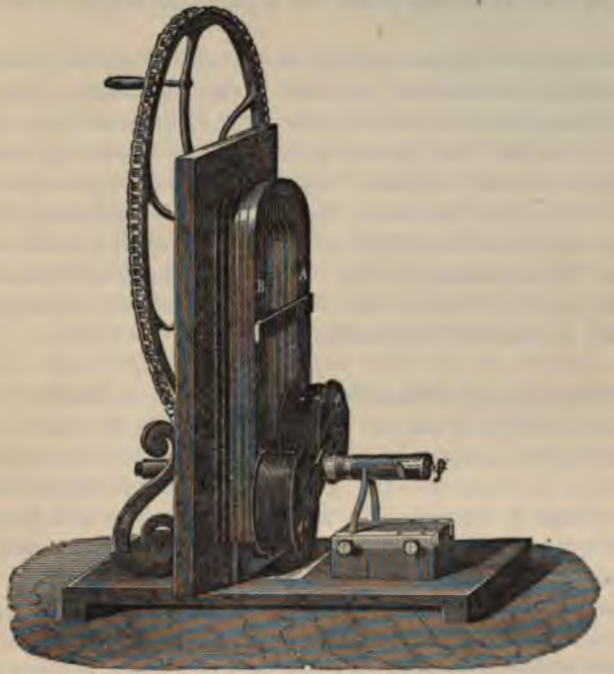

FIG. 14.—MAGNETO-ELECTRIC MACHINE.

Storage Cells, Accumulators, etc.—The Planté cell was the first application of the principle of polarization to the storage of electrical energy. This consisted at first of plates of lead rolled into a spiral, separated by strips of vulcanite, and acted on by dilute sulphuric acid. Such a cell connected with a battery was found to become energized and to give off a considerable current for several hours. The electromotive force of such a cell was determined by the extent of the surface, the seat of the chemical action. The original cell of Planté was made of practical utility by Faure, who improved the amount of chemical energy to be transformed into electrical power by coating the surface of the plates with lead peroxide and by enlarging the surface by mechanical devices. Improvements on the methods of Faure have been made by Brush and many others, so that now a storage cell or an accumulator can be so charged by a battery or dynamo as to give out an amount of electro-motive force only limited by the chemical action occurring at the surface of the plates. Such an accumulator will furnish sufficient power for lighting, heating, or mechanical work.

The storage cell is now employed to furnish light for illuminating the eye, the ear, the throat, and other cavities for cautery purposes in all the varied operations in which the electric knife is used, and, with suitable controllers and rheostats, for the numerous applications of galvanism in medical practice. By means of a storage cell, therefore, the electrical work of an office, including faradic, galvanic, illuminating, and caustic, can be carried on without the agency of the ordinary batteries. When a storage cell is exhausted or has run down, it can be recharged again at the central office, or it can be recharged from the street main by suitable adapter and controller.

The Public Supply of Electricity.—Arrangements are now available for utilizing the public sources of electric lighting and power. There are two forms of the force which can be diverted from the street mains to the office instruments—the arc and the incandescent—and both forms are now in operation in a great many cities and towns. By means of a "current adapter," the current from a sixteen-candle lamp can be fitted to a suitable resistance coil's box and a proper milliampèremeter, whereby the strength can be regulated according to the purposes of the operator; or, by means of a current adapter, the current can be utilized to energize the coils of a faradic battery, whereby the faradic current with all its modifications can be produced. Similarly, the street supply may be brought into service to perform the part of a caustic battery, or it may be used to energize the storage cell, and this in turn be made to do duty as a galvanic or faradic current, or for heating and lighting.

Galvano-Faradization.—The pole-board of a finished electrical apparatus should have an arrangement for combining the galvanic and faradic currents, so that a simultaneous application of the two can be made. Proposed not long since by De Watteville, this form of electrical application has already been largely employed. When the galvanic current is flowing through the electrode wire, the faradic is turned on, thus bringing into action, on a part, the effects of both. To impart a higher tonicity to the organic muscular fiber, to increase absorption of exudates, are the chief purposes to be subserved by this method. To any one familiar with the physiological action of faradism, it will not seem strange that this process can be really useful only when the electrode can be brought into contact with the affected tissue. The application of galvano-faradism has proved of remarkable utility in cases of pelvic inflammation, uterine diseases (subinvolution), and consequent displacements, and excessive proliferation of the connective tissue of the pelvis. The combined currents act more efficiently in these maladies than does galvanism alone.

Electric Baths.—Until two or three years ago electric baths were only used by charlatans, but of late they have been studied from the scientific standpoint, and their real value determined. Water is a conductor, but still an inferior conductor, of electricity. When both poles are placed in the water—a little saline, or slightly acidulated—and the patient immersed, the current passes through the water interposed, and hence the resistance to be overcome will be directly as the thickness of the stratum. Such an application, the water being the medium of communication, has the same character as general faradization, or galvanization. It is a *dipolar electric bath.* When one electrode enters the water, and the other is in contact with the patient, the bath is *monopolar.* In the practice of charlatans it is usual, if the patient complains that he feels nothing, to place a metallic electrode on the skin, when, of course, a lively sense of burning is experienced.

The objections to electric baths are—the necessary trouble to apply them; the enormous resistance of the water; the inequality in tension, and the lack of precision in every case as to the point at which the application is to be made, as to the sudden and considerable variations in the quantity of the electricity furnished, and the unscientific character of the method in every aspect. To these objections may be added the association of electric baths with the most baleful charlatanry. If, indeed, the method possessed such conspicuous advantages that considerations of that character could be disregarded, then it could be placed among our therapeutical resources without compunctions.

Electro-Physiology.—Much of the supposed knowledge of this subject is in a transition state, and will ultimately require very different statement. Into this doubtful region the author will not enter; but there are facts of great value which should not be overlooked.

Action of Galvanism on Motor Nerves and Muscles.—Whether a muscle be acted on directly by a galvanic current, or indirectly through a motor nerve which supplies it, the muscle is thrown into action; but the action is limited to the opening and closing of the circuit if the tension of the current continues the same throughout. If the "descending" or "direct" current has the minimum strength to cause a muscular contraction, this will take place at the closing of the circuit only, and there will be no action at the "opening," or "interruption," or "breaking" of the circuit. A descending, closing-current muscular contraction is always greater than the opening. The rule is different in the case of the "ascending" or "indirect" current. The feeblest strength of current, passing in the inverse direction, which will cause a muscular contraction, induces it only at the opening of the circuit, but, if a strong current is used, both at the opening and closing. Direct excitation of a muscle by galvanism causes more powerful muscular contractions than indirect. Such are the results of galvanic stimulation when the motor nerves are uncovered by tissues, and are directly acted on by the electrodes. If, however, motor nerves and the muscles are acted on through the tissues covering them, the most energetic contractions are induced by inverse or ascending currents, and at the closing of the circuit. When a motor nerve supplies by separate filaments two muscles, stimulation of one filament causes contraction of the muscle to which it goes, but contraction of the other muscles also takes place. To the latter is applied the term *induced contraction.* If a motor nerve is stimulated again and again by a direct current, finally its excitability—that is, its power to contract on irritation—is exhausted; then the excitability may be restored by the action of an inverse current. By thus alternating in the direction of the current, the muscular irritability may be alternately destroyed and restored for a long time, if not indefinitely. To these phenomena has been applied the term *voltaic alternatives.*

Action of Faradism on Motor Nerves and Muscles.—A faradic current, whatever its direction, stimulating a motor nerve, causes contraction of the muscles innervated by this nerve. If the interruptions in the primary circuit are slow, the muscles have time to contract and relax; but when the interruptions are rapid, the muscles are kept in a condition of tonic contraction, or are tetanized. Long-continued, powerful faradic stimulation of a motor nerve exhausts its irritability. Muscles directly acted on by a faradic current contract energetically, but repeated over-stimulation will fatigue and ultimately destroy their contractility. When, however, muscles are in this condition of fatigue and exhaustion, from faradic stimulation, their proper functional state may be restored by passing a continuous galvanic current through them. If not too long applied or too powerful in action, faradic applications improve the nutrition of muscles, and through this increased activity of the circulation there occurs a rise of temperature, generally.

The Polar Method as applied to the Reactions of Motor Nerves and Muscles.—This important method of examining the condition of motor nerves and muscles must be understood, to rightly appreciate the modern mode of electro-diagnosis. As certain terms, having technical meanings, are much used in this connection, it is necessary to define them before proceeding to describe the phenomena. *Anode* is the term applied to the positive pole, *cathode* to the negative pole, and the adjectives, *anodal*, relating to the anode, and *cathodal*, relating to the cathode. As the polar method had its origin in Germany, the symbols now used to indicate electrical reactions are taken from German words. Charcot in France, Buzzard in England, and the American writers in general, have adopted the German formulæ, so now their use is universal.

The polar method consists in exciting nerve or muscle with one pole, while the other rests on some indifferent spot, as the sternum, as advised by Erb. We are here concerned with the normal or physiological state; hereafter, the pathological conditions will be given. The *normal formulæ* consist in the reactions which ensue on polar stimulation, nerves and muscles being healthy. When the current is closed by applying the cathode to the nerve or muscle to be excited, the symbols are Ka S (Ka, *Kathode;* S, *Schliessung*, closing). When the current is opened or broken by removing or disconnecting the cathode, the symbols are Ka O (*Oeffnung*, opening). Corresponding symbols are used in respect to the anode. Thus, the words anodal closing are An S, and anodal opening, An O. To express muscular contraction the symbol is Z (*Zuckung*); a strong contraction is Z′; for a weak contraction, z, and for a tetanic contraction, Te. In the physiological state, the muscular contractions as induced by the polar method are characteristic, and can be expressed in the symbolic language now employed for the purpose. It is to be observed, in the first place, that the cathode or negative pole has more power to induce muscular action than the anode or positive pole.

The cathode has more effect on closing the circuit; whereas the anode acts more powerfully on opening or breaking the circuit.

The normal formulæ of muscular contractions induced by the polar method may be arranged in three grades:

In the first grade, the weakest current having power to induce any contraction causes it on cathodal closing — whence the formula Ka S Z; and no action takes place from the anode.

In the second or intermediate grade, the strength of current is sufficient to cause strong cathodal closing contraction (Ka S Z′), but no opening contraction; whereas, on anodal opening and closing there are feeble contractions—whence An S z, and An O z.

In the third grade, which is the highest, the current causes on cathodal closing a tetanic contraction, Ka S Te, and a feeble contraction on cathodal opening Ka O z; whereas, there occur decided contractions on anodal opening, An O Z, and on anodal closing, An S Z.

Such are the normal formulæ—such is the normal behavior of muscles; but in disease, as we shall subsequently learn, these formulæ may be much changed, may be even entirely reversed.

Action of Galvanism on Non-striated Muscles.—The physiological differences in the action of voluntary and organic muscular fibers are well exhibited in the results of galvanic stimulation. Instead of a prompt, almost instantaneous muscular contraction, characteristic of the voluntary fiber, a slow vermicular motion is set up in the involuntary, and this movement is propagated from the point of stimulation by a rhythmical action.

Action of the Galvanic Current on the Brain and Spinal Cord.—Until the experiments of Fritsche and Hitzig, Ferrier, Nothnagel, and others, within a few years past, the electric excitability of the brain had not been admitted. It seems now to be established that certain areas of the cortex cerebri are anatomically associated with certain muscular groups. These facts have been ascertained by direct stimulation of these areas of the cortex by galvanic (Fritsche and Hitzig) and faradic (Ferrier) applications. Can the intra-cranial organs be reached through their investing tissues? This is the most important question, and to this, fortunately, we are able to reply in the affirmative. Erb was the first to prove the transmission of a galvanic current through the brain, and now the fact is universally admitted.

On electric stimulation of the cord, results are produced according to the functional powers of the part—pain when the sensory tract is irritated, and muscular movements when the motor is acted on. Hence, the statement of Erb, that these effects may be due to stimulation of the nerve-roots, has a high degree of probability. In the spinal cord, as in the nerves, the inverse or ascending current causes more decided effects.

Electric excitation of that part of the cord between the fifth cervical and tenth dorsal vertebræ causes dilatation of the pupil, whence this region is known as the *cilio-spinal region*. The explanation of this fact is, that in this part of the cord originate filaments of the sympathetic, connected with the cervical ganglia. In the lumbar part of the cord is a similar center, related to the genital apparatus, and hence called the *genito-spinal region*.

Action of the Galvanic and Faradic Currents on the Pneumogastric.—A weak galvanic current sent through the pneumogastric, increases the force and rapidity of the heart's movements; but a strong current arrests the heart in the diastole. After division of the nerve, stimulation of its upper or central portion arrests respiration in the movement of inspiration, but does not influence the heart; but a strong current acting on the lower or distal portion of the nerve stops the heart in diastole. A descending galvanic current, passed through the pneumogastric nerve, suspends the contractions of the stomach. A faradic current directly applied to the pneumogastric, before and after division of the nerve, produces the same results, but more decidedly; applied through the tissues, it has no apparent effect.

Action of Galvanism and Faradism on the Sympathetic System.—Covered by the tissues, the ganglia and fibers of the cervical sympathetic are not acted on by faradic and static electricity, but even a weak galvanic current does affect them. Applied directly to the sympathetic nerves, the effect of faradism is tetanizing, and the vessels receiving their innervation from this source contract very strongly. Applied through the tissues, the faradic current has little or no effect.

The kind of action set up by galvanism, and the differences due to the direction in which the current is passing, have been much disputed. The author believes that the experiments and the deductions of Onimus and Legros correctly represent the actual condition. They hold that the direct or descending current, by increasing the normal wave-like or vermicular motion of the muscular layer of the vessels, increases the amount of blood passing through them ; but a very strong galvanic current—forty to sixty milliampère-metres—will tetanize the organic muscular fiber, as we have ascertained by actual investigation, and in this way lessen the quantity of blood passing.

ELECTRO-DIAGNOSIS.—For diagnostic purposes both galvanic and faradic currents are necessary. The polar method has been applied with great success for determining the condition of nerve and muscle. As has been stated, the pole intended for excitation must be placed over the nerve or muscle to be acted on, while the other rests on some indifferent point—for the upper extremity and trunk, the sternum is convenient. If the operator has no assistant, an interrupting handle of the electrode is useful, or an automatic interrupter may be attached to the pole-board, or the interruptions may be effected by simply applying or removing the electrode.

The normal formulæ of nerve and muscle actions have been set forth ; in disease these formulæ are altered—may be, even entirely reversed. It suffices now to state that when a faradic—an induced—current is applied to a muscle, or to the motor nerve supplying it, contraction of the muscle takes place. This is called *faradic excitation*, and it is *direct* when the contraction is caused by application of the electrodes to the muscle itself, and *indirect* when the motor nerve is acted on. When galvanism is used to produce these effects, the term applied is *galvanic excitation*, and this is direct or indirect.

The Diagnosis of Paralysis.—When the paralysis is limited to a group of muscles, to one member, or to one side, the behavior of the paralyzed muscles is compared with the normal. If, however, as is comparatively infrequent, symmetrical muscles are paralyzed, their condition must be contrasted with that of another healthy subject.

The paralysis of muscles may be complete, and yet they react in a normal manner. In other cases, there may be merely quantitative changes ; that is, there is a mere increase or diminution of electric excitability, the polar reactions conforming to the normal, in order. In the third group, the paralyzed muscles are found to be changed, not only quantitatively but qualitatively, in respect to their responses to the electrical excitation. If the muscles respond in a normal manner to both forms of current, it may be concluded that the spinal cord connected by nerve-fibers to the paralyzed part is free from disease.

The changes in respect to the electric excitability, in some cases of paralysis, consist merely in a quantitative increase to both currents: the muscles react to a less strength of current, or more energetically to the same strength. In the latter, while the normal formula is developed by acting on the healthy muscles, on the paralyzed side the reaction is more decided, as indicated by a cathodal closing contraction (Ka S Z) occurring with a very weak current, or Ka S Z becoming, on the application of the same current, a tetanus (Ka S Te); also indicated by the early appearance of an anodal opening contraction (An O Z) and the prompt appearance of a cathodal opening contraction (Ka O Z). A hemiplegia of recent occurrence, some cases of spinal paralysis at a very early stage, and very rarely the earliest manifestations of paralysis from nerve-lesions, are illustrative of this state.

The usual condition for which the electrical currents are employed in diagnosis is diminution or loss of electric excitability. Spinal, motor-nerve, and muscular lesions are the most important. "Reactions of degeneration" is the happy term employed by Erb to signify the changes in the electrical reactions. Owing to disease of the cord, or of the motor-nerve trunks, degenerations of tissue ensue, and hence the term. For a very brief period, in some cases, there is an increase of electrical excitability, but a decline then quickly ensues. As regards faradism, the strength of current necessary to cause a contraction of the affected muscles must be constantly increased, and in a short time no strength of current will cause the least movement. The normal formula for the galvanic current is changed, *pari passu*, with the decline of faradic excitability. First, the cathodal closing tetanus ceases (Ka S Te), then anodal closing contraction (An S Z), and finally cathodal closing (Ka S Z) can be excited only by the strongest current. These changes represent a gradually increasing atrophy of the muscles, and the final cessation of the cathodal closing contraction signifies an extreme degree of atrophy, and the disappearance of the muscular elements.

In the condition known as the reactions of degeneration, it is important to distinguish between the reactions of the motor nerve and of the muscles. It has been already pointed out that, whether the motor nerve supplying it, or the muscle itself is acted on, muscular contractions take place. In the changes which ensue in cases of paralysis, the state of the nerve is separable from that of muscle. If the paralysis is due to a lesion of the nerve-trunk—to an inflammation of the nerve, for example—there may be a brief period when, as above stated, the electric excitability is heightened; but, as the nerve undergoes degenerative atrophy, there ensues a quantitative decline in the response to electrical excitation, to both faradic and galvanic, and by the twelfth day, sometimes earlier, it has usually entirely disappeared, if the lesions have proved destructive and irremediable. On the other hand, if the injury done is less, and is remediable, the electric excitability is modified only, and not lost. When recovery from the injury, or inflammation of the affected motor nerves takes place, the muscles innervated will respond to the impulses of the will, long before they react to faradic or galvanic stimulation.

When the spinal cord is the seat of disease, as in infantile paralysis, glossolabiolaryngeal paralysis, progressive muscular atrophy, etc., the paralyzed nerves and muscles exhibit most characteristic electrical reactions. As regards the motor nerves, in two or three days, usually, after the paralysis has manifested itself, a regular and steady quantitative decline in excitability to both forms of current takes place, and by the end of the second week, usually, and sometimes by the end of the first week, no strength of current applied to the nerve will cause muscular contractions. At first, cathodal closing ceases, then anodal closing, and finally anodal opening.

The muscular reactions are much changed from the normal. The muscles, in about a week after the paralysis appears, begin to decline in their excitability to the faradic current, and, at the end of two weeks, it is totally lost, and they cease to respond to any strength of application. If regeneration of the diseased nerve-tissue can be effected, restoration of the faradic excitability may be accomplished, but to a less extent than before.

The phenomena connected with the galvanic excitability are very different. For the first week of the paralysis the response of the muscles to the galvanic current declines, as it does to the faradic ; but, after the second week, a remarkable change ensues : then the galvanic excitability begins to increase, and with this there occur qualitative changes in the order and mode of muscular contractions. These consist in a gradual increase of the anodal closing contraction, which soon equals if it does not surpass the cathodal closing, and the cathodal opening contraction declines in the same measure. In other words, an actual reversal takes place of the normal formulæ. If the degenerations continue, and the muscular elements are finally destroyed, the reactions ultimately cease, the last to disappear being a very feeble anodal closing contraction. Such are the *reactions of degeneration.* They occur in cases of spinal paralysis, when the disease in the cord is in direct anatomical association with the paralyzed parts, and in cases of peripheral paralysis when due to injury or disease of nerve-trunks. The so-called infantile paralysis is an illustration of the former, and facial paralysis of the latter. When the disease is situated in the cord above the point from which nerves are given off to the paralyzed members, there is no change in the law of muscular contraction. When, for example, a transverse myelitis exists entirely above the dorso-lumbar enlargement of the cord, the muscles of the lower extremities, although paralyzed, react normally to the faradic and galvanic currents. Again, in disseminated myelitis there are groups of muscles that react in accordance with the law of normal contraction, and other groups that manifest the reactions of degeneration—the former being in anatomical connection with a healthy part of the cord; the latter with a diseased area. It follows, therefore, that a proper electrical examination should be made as a means of diagnosis in the diseases of the nerve-centers.

Diagnosis of Sensibility.—By means of the faradic brush, and pointed electrodes closely approximated, the state of sensibility of the skin may be readily marked out. The skin must be carefully dried to prevent diffusion of the current, and then the brush or electrodes conveying the induced current must be carefully passed over the supposed anæsthetic and analgesic area, and the outlines of the affected surface thus ascertained.

The galvanic current by the polar method has been very successfully applied to determine *the state of the auditory nerve.* The pole intended for excitation is introduced through a suitable non-conducting speculum into the ear, previously filled with warm water, and the other pole is placed on the mastoid process, nape of the neck, or any indifferent point. Brenner, of St. Petersburg, who has contributed the most of the exact knowledge now in our possession regarding these auditory reactions, has invented resistance-coils to be utilized in these researches. A strong current, reduced to the necessary point for acting on the auditory nerve by the introduction of sufficient resistances, is passed through the organ, and the resulting sounds, subjective, and audible, of course, only to the patient, indicate the condition of the nerve. These sounds, whistling, singing, roaring, etc., have been reduced to formulated expressions. Although there are differences of opinion in regard to the real value of these auditory reactions, it seems to be now well established that Brenner's method and formulæ are correct in the essential details.

The state of gustatory sensibility is most correctly ascertained by galvanic stimulation of the end-organs of the nerve. For this purpose a pointed electrode, the positive and negative as closely approximated as possible, is carefully passed over the area of distribution of the sense of taste, and its condition noted.

Feigned paralysis may sometimes be detected by faradic stimulation of the muscles, and feigned insensibility by a strong current. Hysterical paralysis is remarkable for the absence of electro-sensibility and the presence of electro-contractility.

THERAPY.—*Manipulation.*—Electrodes for the application of galvanism or faradism are of various shapes and materials. The best, probably, is a disk of carbon covered with wash-leather. A metal disk covered with soft sponge is also much used. The size depends on the purpose to which applied. When large volume and high intensity are the qualities of the current, the electrode should be of large size, of soft sponge, well moistened. For application to small muscles, Duchenne's olive-shaped, curved electrodes are most suitable; and to individual nerves, metal buttons of various shapes covered with wash-leather. The instrument-makers are now supplied with all forms and kinds of electrodes, so that the operator can always obtain what form of electrode soever he may desire.

When it is intended to act on parts beneath the skin, the electrodes and skin should be well moistened, for the conductivity of the tissues is in direct ratio with the amount of water they contain. On the other hand, if the skin alone is to be acted on, it should be well dried to prevent diffusion of the current. When weak galvanic applications are made, but little tingling is felt by the patient, and hence he may suppose that no curative effect is produced. Under such circumstances, it were better to add a little salt to the water with which the electrodes are moistened.

Electrical applications should always be made to the affected part, and also to those parts in which decided symptoms are felt. The principle of *localized electrization*, as established by Duchenne, was a most important advance. Next, *the polar method* did much to give exactness to methodical applications. When the poles have a fixed position, and are not moved, the application is said to be *stabile*, and, when moved over the part operated on, *labile*. If the direction the galvanic current is taking is parallel to the nerve-current, or from the center toward the periphery, the application is said to be *direct*, or *descending;* if in the opposite direction, *indirect*, or *ascending*.

General electrization is a term used to indicate the application of either current to the whole surface of the body—one pole placed on the nape of the neck, or to the feet, and the other passed over the whole surface of the body. *Central galvanization* is a term invented by Beard and Rockwell to signify applications to the cervical sympathetic, to the pneumogastric, to the cervical and dorsal parts of the spinal cord, and to the solar plexus. If one pole be placed on the seventh cervical vertebra, and the other in the fossa behind the angle of the jaw; if the former be kept in this position, and the latter put on the epigastrium; and, lastly, if the first be moved down the spine to a point opposite the second—there will be brought into the circuit, successively, the ganglia of the cervical sympathetic and their cardiac branches, the pneumogastric, spinal accessory, phrenic, the semilunar ganglion and solar plexus, and the spinal cord.

In what mode soever applied, and at what point, more or less diffusion of the current takes place. Although the current flows from the higher to the lower potential by the most direct route, a greater or less deflection is caused (diffusion) by the resistance encountered on the circuit.

Magneto-Therapy.—The force furnished by the magnet—magnetic polarity—produces distinct effects when applied to plants and to animals, and it has been utilized in the treatment of diseases. It has been shown by Dr. Vansant that the south pole of the magnet applied to a sensitive surface causes pain, while the north pole is free from this action, and indeed relieves the pain caused by the former. Small animals are similarly affected, the south pole causing excitement, and the north pole sedation. Sometimes remarkable curative results are obtained by the application of magnets in *neuralgia* and in *chorea;* but they often fail utterly. In hysterical affections, *hemi-anæsthesia, contractures,* etc., the results are more constant, and, indeed, are often very striking. It is quite impossible to separate the influences due to the imagination from the direct action of the magnet.

The form of magnet used in medical practice is chiefly the horseshoe, and, to obtain sufficient power, several permanent magnets are clamped together. The magnetic pole with which the effect is intended to be produced may be gently stroked along the course of the nerve in cases of neuralgia, or the magnet may be fastened on the part by suitable straps. The duration of the application will be determined by the effects. In some cases the result is little short of magical; in others, apparently of the same character, no effect follows.

Galvano-Therapy.—The most important curative results are wrought by galvanism. As a rule, the large, two-fluid elements of the permanent battery are much more effective therapeutically than the small portable combinations. In the Siemens and Halske modification of the Daniell cup, which is so much employed by German electro-therapeutists, and which the author also uses, the resistance within the battery is very great, nearly equal, indeed, to the resistance of the body. Hence, the current is smooth and uniform, and hence, also, the good results obtained from it.

Allbutt made a number of experimental observations at the West Riding Lunatic Asylum on the therapeutical effects of electricity (galvanism) in *psychical disorders,* and he sums up his results as follows: Marked improvement in *acute primary dementia;* distinct improvement in *mania, atonic melancholia,* and perhaps recent *secondary dementia;* no change observed in *chronic dementia* and some cases of melancholia, and an unfavorable effect in *hypochondriacal melancholia,* and perhaps *brain-wasting.* In the cases reported by Allbutt, the current was sent through the head and through the cervical sympathetics. Benedict (page 222) reports three cases of mental disorder improved by galvanism.

I have observed excellent results in the mental and other symptoms—*confusion of mind, impaired memory, hypochondriasis, vertigo,* etc.—which result from imperfect nutrition of the brain, caused by atheromatous degeneration of the cerebral vessels. My method of application has consisted in transverse transmission of galvanism through the brain, using a current of sufficient intensity merely to cause slight giddiness, a faint metallic taste, and barely perceptible flashes of light.

Galvanization of the brain and of the cervical sympathetics is one of the measures to be resorted to in *acute active or passive congestion of the brain. Wakefulness*, when not reflex in origin, and when dependent simply on the state of the vascular supply, is often relieved by galvanization of the brain. Insomnia may be dependent on either active or passive congestion. In the first case a *continuous* current of moderate intensity should be passed through the superior ganglion of the sympathetic—the positive pole being placed in the auriculo-maxillary fossa, the negative on the seventh cervical vertebra; in the second case a mild current should be transmitted transversely through the brain, and be slowly interrupted.

To promote absorption of the clot in cases of *cerebral hæmorrhage*, and to relieve the *collateral œdema in embolism* of the cerebral arteries, very mild galvanic currents may be employed. Caution is necessary, however, in employing galvanism in such cases. Strong currents and lengthened applications may do serious mischief; but the author believes, with Remak, that judicious application of galvanism will be useful. The immediate effects of the embolism, or of the hæmorrhage, should be allowed to subside before commencing the use of electricity, and, if there be much headache and vertigo, the greatest circumspection will be necessary.

In *hemiplegia* the constant current may be applied to the brain, for the purpose of improving its nutrition, and the faradic or induced current to the muscles, to prevent wasting and loss of function from disuse. If the temperature of the paralyzed parts is lowered, the skin discolored and roughened, the muscles weak and flabby, much improvement in all these particulars will follow faradization. Large electrodes, well moistened, should be used, and all the muscles should in turn be made to contract—one pole being placed over the motor nerve, the other over the bellies of the affected muscles. In cases of hemiplegia, when the nutrition of the skin and muscles has been improved to the extent which faradization can accomplish, no advantage can accrue from further persistence in the applications. In faradizing the muscles in a case of hemiplegia, a current of just sufficient intensity to cause contractions should be used. Tetanic cramps fatigue the muscles, and are harmful. The so-called "late rigidity"—the muscular contractions which ensue after a time in hemiplegia, and which occur chiefly in the forearm and hands—is best treated by a continuous current to the contracted flexors, and an interrupted or faradic current to the relatively weaker extensors.

In recent affections of the spinal cord, as a rule, electricity is not indicated. In *chronic myelitis, syphilitic diseases of the meninges,* after a course of suitable specific treatment, and in some of the sequelæ of *acute meningitis,* much good may be accomplished by the galvanization of the spine and the paralyzed muscles. The wasting of the affected muscles may be arrested and their nutrition raised to the normal, and the paralysis of the sphincters may, in many cases, be relieved. When the electro-contractility of the muscles is not impaired, and when they have not wasted, no good is to be accomplished by stimulating them with the electrical current.

That very troublesome disorder, *spinal irritation,* with its extensive irradiations of nerve-pain, is much benefited by an inverse galvanic current, according to Hammond, and this observation I have been enabled to confirm by my own experience. *Hysterical paralysis* of the extremities, accompanied or not with anæsthesia or hyperæsthesia, should be treated by galvanization of the spine and faradization of the muscles.

In *paralysis from lead* (dropped wrist), the muscles may be so far atrophied as not to respond to faradization, but may react when stimulated by a slowly-interrupted galvanic current. When this condition exists, the interrupted galvanic current must be first employed, and the cure be completed by the faradic current when the muscles are so far improved as to react to the latter.

The best example of a *peripheral paralysis* is that of the *muscles of the face,* from disease or injury of the facial nerve. From exposure to cold, or disease of the ear, or traumatic injury, the nerve is damaged, and the muscles to which it is distributed are paralyzed. In accordance with the law already given, such muscles do not respond to the faradic current, but do react to galvanism. The positive pole is placed over the *pes anserinus,* or on the mastoid process, and the negative is made to pass over the peripheral expansion of the nerve, so that all the muscles innervated by the nerve are brought into action. A current of sufficient intensity to induce muscular contraction must be employed. As in the case of other peripheral paralyses, after a time the affected muscles recover their power of response to faradism, when this form of current may be used to complete the cure. If the nerve has not been irremediably damaged, and if the paralysis has not existed so long that the electro-contractility is lost in consequence of atrophic degeneration of the muscles, a cure of facial paralysis may be effected by a persistent use of electricity.

Certain of the ocular paralyses, as of the *third, fourth,* and *sixth nerves,* are often cured by electricity (interrupted galvanic current). It is necessary, in order to obtain a successful result, that the remedy be employed in suitable cases. When these paralyses are dependent on cerebral tumors, syphilitic gummata, exostoses, etc., electricity can not be expected to cure; but the paretic state of the muscles, left after the removal of the gummata, may be promptly relieved by galvanization. The functional states of the above-mentioned nerves, of which paralysis may be a symptom, will certainly be cured by electricity. Faradism may sometimes succeed when galvanism fails in these cases (Althaus).

Cases of *aphonia*, when dependent on paralysis of the vocal cords, are sometimes cured by a single application, and few, indeed, resist the proper use of galvanism. The larynx may be faradized externally; the recurrent laryngeal may be galvanized by placing one rheophore over its trunk and the other over the larynx, or, what is better, an intra-laryngeal electrode (Mackenzie's) may be used.

Paralysis of the bladder and of the *sphincter ani*, even when symptomatic of spinal affections, may be greatly benefited, and the condition of the patient rendered much more comfortable, by an interrupted galvanic or faradic current applied by suitable insulated electrodes. Idiopathic cases of these affections may be cured in this way. *Constipation*, due to atony of the muscular layer of the large intestine, can be overcome by the same means. An insulated electrode is introduced into the rectum, and a large sponge-covered rheophore, well moistened, is passed over the abdomen so as to bring every part of the large intestine within the circuit.

The failure of respiration in *opium narcosis* can be most successfully obviated by faradization of the muscles of respiration. A strong faradic current is one of the most effective means of causing uterine contractions in cases of *post-partum hæmorrhage*.

In certain of the "*myopathies of spinal origin*," but not in all of them, electricity gives excellent results. The most decidedly curative results are obtained in *infantile paralysis*. The electrical treatment should be begun early, but after the subsidence of all inflammatory symptoms. Good results may be looked for if the electro-contractility of the muscles is not lost, and if important changes have not occurred in the joints. In many cases the affected muscles, although not atrophied, do not respond to the faradic current, but will to the interrupted galvanic. The latter should therefore be used until the muscles are put into a condition to respond to the former. Besides galvanization and faradization of the paralyzed muscles, the electrical treatment should include galvanic spinal-nerve and plexus-nerve currents. Thus far but little benefit has accrued from the electrical treatment of *progressive muscular atrophy*. If the initial change in this malady were myopathic (as asserted by Friedreich), good results from localized faradization might be obtained. The author's most recent experience as to the curability of this disease by electricity is not in accord with Onimus and Legros's, who declare that it is without avail in this disorder, for it does appear to have the power, in some instances, of arresting its progress. *Posterior spinal sclerosis* is sometimes retarded in its course and progress by electricity, and galvanization of the spine lessens somewhat the severity of the neuralgic pains which belong to this malady. Recently it has been shown that persistent use of the faradic brush to the spine, body, and extremities, is in suitable cases remarkably effective. Of all the remedial means now employed, this is the most promising, for Strumpf, of Düsseldorf, who has revived this treatment, reports not only amelioration but apparent cures of this before intractable disease.

Nothing is more certain in therapeutics than the relief to *pain* by galvanization of the affected nerve or nerves. In *tic-douloureux* decided relief to the pain is obtained by electrical applications to the fifth, and a permanent cure not unfrequently results in those cases belonging to the category of the essential neuralgiæ, so called. The best method of application is that advised by Onimus and Legros, which consists in placing the positive pole on the point of emergence of the affected nerve, and the negative over the superior ganglion of the cervical sympathetic. About ten elements of Siemens and Halske is the proper strength, and five to eight minutes the proper time, for these applications. This method of treatment is, according to Frommhold, the most effective remedy for *migraine* or *hemicrania.*

In *cervico-brachial neuralgia*, and in *sciatica*, excellent results are obtained by galvanization of the affected nerves. The positive pole should be placed over the point of emergence of the nerves from the cord, and the negative over the main divisions of the peripheral expansion. Both labile and stabile currents may be employed. A current from thirty elements will usually be required. The electrodes should be large sponges well moistened. In old cases of neuralgia, a needle such as is used for acupuncture, but insulated to near its point, may be introduced down to the neighborhood of the nerve-trunk and attached to the positive pole, while the negative sponge-electrode may be passed over the course of the nerve. This mode of galvanization is especially to be recommended in old cases of sciatica. A daily *séance* of from five to fifteen minutes is required usually in cases of neuralgia. The cure is much more difficult, and the applications must be continued over a much longer period of time, in those cases of neuralgia dependent on neuritis. Decided amelioration and even cure may be hoped for by sufficiently prolonged applications, when the nerves are so far altered that induced currents do not cause any muscular contractions. Some of the most satisfactory results have been obtained from galvanization of the uterus in uterine and ovarian nerve-pain.

In certain kinds of *muscular spasm* the galvanic current has unquestioned utility. Cases of spasmodic *wry-neck* (torticollis) of recent origin, due to "rheumatism," are quickly relieved by galvanization by stabile currents of the affected muscles, and faradization of the opposed muscles. Old cases of wry-neck and convulsive tic of the face, and writer's cramp, are not benefited by this treatment. Cases of *chorea* have been cured by static electricity, but little benefit has been derived, according to the author's observation, from galvanism or faradism.

Galvanism is sometimes of great service in *epilepsy*, but no exact indications for its use can be laid down. Obviously it can only be serviceable in idiopathic epilepsy. The applications should include the brain (transverse current from mastoid process), the cervical sympathetic, and those nerve-trunks along which an aura is transmitted.

The author has witnessed some remarkable results from the galvanization of the pneumogastric nerves, and as conspicuous failures from the same practice, in *spasmodic asthma*. Even in those cases not permanently improved, great relief to the difficult breathing is experienced when the current is passing. The positive pole is placed over the pneumogastric, beneath the mastoid process, and the negative pole is applied to the epigastrium. Faradism is not serviceable in this disease.

Exophthalmic goitre, a disease of the sympathetic system and manifested objectively by proptosis, goitre, and palpitation of the heart, is cured by galvanization of the cervical sympathetic and of the pneumogastric, and by applications to the eyes and thyroid gland, when it is merely functional in character.

There can be no reasonable doubt of the influence of electricity over the nutritive functions. Beard and Rockwell employ the method termed by them "general electrization," which consists in faradic applications to the surface of the body, "one pole, usually the negative, being placed at the feet or the coccyx, while the other is applied all over the surface of the body." They formulate their principles in these applications as follows: "Constitutional diseases are better treated by general, and local diseases by localized electrization." According to Benedikt—and in this view electricians are generally in accord—the true method of using electricity consists in making applications to the affected part or organs, and, to this rule may be added, to those parts or organs also in which symptoms are felt.

General electrization is useful "in those diseases that are dependent on, or associated with, impairment of nutrition and general debility of the vital functions, such as *nervous dyspepsia*, *neurasthenia*, *anæmia*, *chlorosis*, *hysteria*, *hypochondriasis*, *paralysis*, and *neuralgia* of a constitutional origin, *rheumatism* and other toxic diseases, some forms of *chorea*, and oftentimes in functional disorders of the genital, digestive, and other special organs."

In *anæmia* and *chlorosis* the usual remedies for these states may be much assisted by central galvanization, and localized applications to the vegetative organs. *Regurgitation of food*, *gastralgia*, and *feebleness of digestion*, are often signally benefited by galvanization of the pneumogastrics, and by localized applications to the abdominal organs. Strong currents are needed when internal organs are to be affected by electrodes applied to the integument of the abdomen. A more effective application in these cases consists in the use of an insulated rectal electrode, while a sponge electrode of large size, and well moistened, is passed over the various organs of the abdomen. The relief of constipation by this means has already been alluded to.

Various diseases of the pelvic organs, both in the male and female, are successfully treated by electricity. *Amenorrhœa*, when dependent on atony of the ovaries and uterus, is cured by static electricity, by faradism, or by an interrupted galvanic current. A shock from a Leyden-jar may be transmitted through the pelvis, or a strong faradic or galvanic current may be applied by means of one pole on the spine, the other on the hypogastric region. In the case of married women an insulated vaginal electrode may be introduced and placed in contact with the os uteri. This is a more effective way of making the applications than by the electrodes placed externally. In *neuralgic dysmenorrhœa* the galvanic current will afford relief in a large proportion of cases; and, in *congestive dysmenorrhœa*, an inverse current will diminish the blood-supply, and thus lessen suffering. The treatment of these affections should be conducted during the interval. The *chronic congestive enlargement of the uterus* is sometimes remarkably benefited by a galvanic current of moderate intensity slowly interrupted, but it is doubtful if any case of chronic interstitial metritis is ever cured, or even ameliorated, by this means.

Although the changes in the joints, induced by gout and rheumatism, may not be cured by galvanization of the central nervous system, as claimed by Meyer, yet there is no doubt that *myalgia, lumbago*, and other so-called rheumatic diseases of the muscular system, may be promptly relieved and cured by the constant current. The *stiffness of the joints* and the *muscular soreness* which remain after an attack of acute rheumatism are best relieved by passing a mild galvanic current through the affected parts.

Herpes, especially *herpes zoster*, and *prurigo*, when they are referable to an alteration of the cutaneous nerves, are curable by electricity. The author has seen excellent results in cases of shingles, from galvanization of the affected intercostal nerves—the positive pole being placed over the point of emergence of the nerves, and the negative brushed over the terminal filaments in the skin. Beard reports the cure of obstinate cases of *chronic eczema* by central galvanization, and his results have been confirmed by others. The author has seen a number of cases of *acne* get well under the influence of galvanization of the cervical sympathetic, and local galvanization of the skin of the face—the positive pole on the neck, the negative passed over the affected parts. It need hardly be stated that strong currents are not to be used when the poles are applied in these situations. Among the other skin-affections treated by galvanism with success are *prurigo, psoriasis*, and even *scleroderma*; but, as Dr. Piffard, of New York, has remarked, this method is "by no means uniformly successful." It is applicable to the treatment of the *neuroses of the skin.*

ELECTROLYSIS.—When the electrical current is made to traverse insulated needles introduced into the tissues of the body, electrolytic effects are produced, decomposition of the tissues ensues, hydrogen and the alkalies appear at the negative pole, and acids and chlorine at the positive. Remak, in his various publications, much insisted on the catalytic action of the constant current. Effusions into and about inflamed parts, and into the substance of tumors, may be made to disappear by the external application of galvanism, through moistened sponge-electrodes. It is doubtful, however, whether neoplastic formations can be thus made to undergo absorption. The disappearance of effusions induces such an appearance of shrinking of tumors and inflammatory products, that actual absorption of the neoplastic material may be supposed to have occurred.

Galvano-puncture is used to remove *malignant* and other *new formations.* The sanguine expectations once entertained that cancer can be thus removed, although justified by the results in a few apparently successful cases, have not been realized. Beard proposed and has executed a new method, entitled "working up the base," which consists in electrolytic decomposition of the subjacent parts of a cancer. A number of needles, insulated to near their points, are introduced into the healthy tissues beneath the morbid growth, and a current from twenty to sixty elements is passed through them. Decomposition ensues, and there takes place a separation of the morbid mass. As the pain of this method is great, etherization should be resorted to.

Aneurisms, so situated as to be beyond the reach of surgical interference, have been treated by galvano-puncture, but the success, although brilliant in a few instances, has not been such as to justify very sanguine expectations of its future utility. *Erectile tumors* are curable by electrolysis. *Goitre* is sometimes made to disappear by the same means. The *cysts* connected with glandular tumors in the neck may be permanently occluded by galvano-puncture. The most useful applications of this method have been in *hydrocele*, which may be often cured in my experience by introducing two needle-electrodes, insulated to near their points, and passing a current from twenty to forty elements. Not less effective is the same method in the treatment of *hydatid* disease of the liver. One needle connected with the negative pole is introduced, and the sponge-electrode is placed at some indifferent point on the abdomen.

Spasmodic and *permanent stricture of the urethra* are treated by electrolysis, an insulated sound with a metallic tip, connected with the negative pole, being passed into the stricture, and the positive pole placed at some indifferent point. The most successful results have been obtained by Mallez and Tripier, and Dr. Robert Newman, of New York; but it is the author's observation, as also the experience of Dr. Keyes, of New York, that this method has little real utility.

Wounds and *ulcers* of an indolent character, and *bed-sores*, may be made to heal by attaching to them a galvanic couplet (zinc and silver), one of the elements remaining in contact with the sore, and the other on the skin in the neighborhood. They should be connected by a copper wire, and be confined to the parts by strips of adhesive plaster. This method has been especially serviceable in the treatment of bed-sores.

CATAPHORESIS.—Du Bois-Reymond applied this term to signify the transference of certain medicaments by the galvanic current through the skin or mucous membrane from one point to another. The movement is a kind of osmosis or diffusion, and takes place from the positive pole—the anode—to the negative pole—the cathode. The action is mechanical, and not chemical or electrolytic. The medicaments thus transferred through the tissues have been chiefly anodynes and preparations of iodine, although experimentally, in the way of proof of the fact, many different kinds of substances have been employed for this purpose. It is necessary to the process of cataphoresis that the medicine to be thus transferred be in solution, and one capable of diffusion. The skin offers the greatest opposition to the transfer. Dr. Corning, of New York, sought to overcome the resistance of the skin by perforating it by means of a Baunscheidt-needle instrument at the point of application of the anode.

The apparatus required for the process of cataphoresis consists of a galvanic battery of the strength of five milliampères up, of a suitable electrode for containing the medicament, and the substance to be transferred in proper form for the purpose. An ordinary sponge electrode moistened with a solution has been used successfully, but greater precision than such a method admits of should be employed. The best electrode for the purpose probably is one of carbon having an outer rim of leather or other soft material to adapt itself to the skin. A nickel-plated disk may be used also. A bit of paper or linen cloth of the proper size is laid on the electrode, and the solution is dropped on. Such disks of paper or linen may be impregnated with a defined amount of the solution, dried, and when required for use can be moistened. Dr. Morton has substituted for Dr. Petersen's paper soluble gelatinous disks duly impregnated with the drug to be used in this way.

The method of cataphoresis is employed in neuralgia chiefly, and by means of cocaine, morphine, aconite, chloroform, and other anodynes. Vesication quickly follows the application of chloroform—so easily and quickly as to make this a nice method of raising a blister.

The lithium salts are used in cases of rheumatic or gouty affections of joints. Similarly, the iodides are employed in the treatment of strumous and syphilitic affections, and in deformities arising from muscular lesions.

As the skin offers the greatest obstacle to the passage of the current and also of the anodyne solution, punctures with a Baunscheidt instrument may be usefully made in advance of the application of the electrodes. By such an expedient we have the effects of a counter-irritant superadded to the action of cataphoresis, as well as facilitating the anodyne treatment. A mixture corresponding to that in Schleich's method may be utilized under these circumstances.

Galvano-Cautery.—This method consists in cauterization by a platinum wire heated by the galvanic current. The battery used for this purpose furnishes a large quantity of electricity of low tension; hence the elements are few in number but have extensive surface. When a quantity of electricity is made to traverse a platinum wire which offers great resistance, the wire is heated and may be melted. The platinum in the form of wire-loop, or dome cautery, or knife, heated by the electrical current, is the cauterizing agent. If the wire be not so highly heated as to cut through the tissues too rapidly, but little bleeding results, and a clean surface is left which promptly granulates and heals.

Cities of any considerable size are now usually provided with a public electrical supply, by means of which all forms of electrical application can be made by the interpellation of a suitable "controller," or other means of modifying the current; or storage-cells, dry or with liquid elements, may be used as the means of force if suitably charged. A storage system consists of an element or combination of elements which may be charged by another battery. The form of "storage-cell" or "accumulator" now chiefly used consists of plates of lead immersed in dilute sulphuric acid. These are charged by some Daniell or Bunsen cells, communicating with them, and in action for several hours. Bubbles of hydrogen gas form on one lead plate, and of oxygen on the other; whence they are said to be "polarized," and the current produced by the recombination of the gases is called a "current of polarization." By such an arrangement the quantity of electricity furnished by some Bunsen or other cells, acting for many hours or days, can be given out in a short time and in immense quantity. The accumulators of Faure, charged in Paris, have been transported across the ocean to give out their force in New York. Trouvé has utilized this principle in constructing his "polyscope." A storage-cell of Planté is charged by the action of two Bunsen elements, and subsequently the stored-up electricity can be employed in heating a platinum wire or knife for cautery purposes, or for illumination.

STATIC ELECTRICITY.—The modified Holtz or Toepler-Holtz electrical machine is now used to procure all of the nerve and muscular effects hitherto obtained by faradic electricity, and also therapeutical results of a very striking kind. It has long been known that chorea and other nervous affections may be readily cured by static electricity, but a remarkable extension has been given to the subject by late discoveries. *Chorea* is now treated by the "electric bath," sparks being drawn from the spine. If the Holtz machine is used, sparks can readily be drawn through the clothing by presenting the brass knob along the spine. The results, which have been so long obtained at Guy's Hospital by this mode of electrical applications, are now generally conceded. It seems to be the most successful method of treating this disease. *Neuralgia* is now promptly relieved in most instances by insulating the patient and drawing sparks from along the trajectory of the nerve affected. The pains of *progressive locomotor ataxia* are much benefited in the same way, and it is said the disease itself is arrested. *Amenorrhœa*, other conditions favorable, is quickly cured by sparks, or a shock sent through the pelvis. The *general nutrition* is greatly promoted by electrization by sparks.

The Toepler-Holtz machine may, by connecting the interior of one condenser with the exterior of the other, be utilized to procure the muscle and nerve reactions of the faradic current.

Trouvé's Polyscope, referred to above, will probably be largely employed in the future, for the purposes of illumination. Suitable throat and other mirrors, platinum knives, and loops, are furnished with the instrument for illumination of the cavities, and for the various caustic operations. It is very powerful, occupies but little space, and promises, when certain mechanical defects are overcome, to fulfill more perfectly than any other apparatus the requirements of a surgical galvano-caustic and a medical illuminating apparatus.

THE ROENTGEN OR X-RAYS.

It has long been known that ordinary white light is a combination of light, heat, and chemical rays, the red end of the solar spectrum being the least, and the violet the most refrangible. In the violet end of the spectrum, and beyond, are contained the chemical rays. The ethereal vibrations, or impulses, occurring in this position, are not the regular, successive movements that produce light, but a less orderly disturbance of the ether. These so-called X-rays have the power to penetrate many bodies opaque to ordinary light—as flesh, wood, paper, and other fibrous materials. It has been found that substances and structures of considerable thickness and high atomic weight are less permeable to these rays. For example, when the rays are passed through the extended hand, the muscles, connective tissue, and fat are transparent to them, while the bones are opaque, and hence appear in distinct outlines on the photographic plate.

The Equipment for an X-Ray Apparatus.—The several parts required for the production of these rays are—1, a static machine, or a supply from the street mains; an induction-coil; 2, a vacuum-tube in which the rays are excited; 3, the fluorescent screen, or fluoroscope; and 4, the photographic plate, on which the image of the part is taken.

The static machine employed for this purpose is usually of the Holtz form, or some modification of this instrument. There must be a sufficient number and size of the revolving plates to furnish a spark of proper volume.

The current may also be obtained from a coil charged by the street mains, or by a dynamo, or by a storage or gravity battery.

The most important part of the apparatus for producing the X-rays is *the vacuum-tube*, originally a Crookes tube. This is a glass bulb 10 centimetres in diameter, with metal terminals—cathode, anode, and the anticathode or *target*. The cathode and anode are made of aluminum, and the target for the reception of the cathode stream is composed of platinum alloyed with iridium. In the single focus-tube the anode and target are combined, and is then made of the alloy of platinum and iridium.

Next in importance to the vacuum-tube is the fluorescent screen for the separation of the X-rays. This is a piece of cardboard coated uniformly on one side with tungstate of calcium or platino-chloride of barium. The size of the screen varies with the size and position of the part to be examined.

The photographic plate for receiving an impression of the part under examination is the final part of an equipment for X-ray work.

The use of the X-ray for diagnostic and therapeutic purposes has become an indispensable adjunct in surgical and medical practice.

Nux-Vomica.—The seeds of *Strychnos nux-vomica* Linné (Nat. Ord. *Loganiaceæ*). (U. S. P.) *Noix vomique*, Fr.; *Krähenaugen*, Ger.

Extractum Nucis Vomicæ.—Extract of nux-vomica. Dose, ⅙—gr. ½.

Extractum Nucis Vomicæ Fluidum.—Fluid extract of nux-vomica. Dose, ♏j—♏v.

Tinctura Nucis Vomicæ.—Tincture of nux-vomica. Dose, ♏j—♏xv.

Composition.—Nux-vomica contains two alkaloids and a peculiar acid. The alkaloids are *strychnine* and *brucine*, and the acid *strychnic* or *igasuric acid*. The proportion of strychnine ranges from one fourth to one half of one per cent, and of brucine from one eighth to one per cent. These wide differences are in great part due to the varying skill of the chemists who have made analyses. Besides these, another crystallizable base has been discovered in the mother-liquor from which strychnine and brucine have been precipitated. This has been named *igasurine.* The alkaloids exist in nux-vomica in combination with igasuric acid.

Strychnina.—Strychnine. Occurs in colorless, transparent, octahedral or prismatic crystals, or as a white crystalline powder, odorless and having an intensely bitter taste. Soluble at 59° Fahr. (15° C.) in 6,700 parts of water and in 110 parts of alcohol. Also soluble in 7 parts of chloroform.

Strychninæ Sulphas.—Strychnine sulphate. A white salt, in colorless, prismatic crystals, odorless, exceedingly bitter, soluble at 59° Fahr. in 50 parts of water, sparingly soluble in alcohol, and insoluble in ether. Effloresces on exposure to the air, and melts when heated, losing nearly fourteen per cent of its weight of water of crystallization. By a strong heat it is wholly volatilized. Dose, gr. $\frac{1}{60}$—gr. $\frac{1}{30}$.

Brucinum.—Brucine. Is not official, but is a constituent of nux-vomica, possessed of distinct physiological actions, similar to, but by no means identical with, strychnine. It is alleged to have analgesic effects when applied locally to the mucous membrane, but this property has not been utilized to any extent in practice.

Antagonists and Incompatibles.—The paralyzers, such as woorara, conium, tobacco, opium, belladonna, and physostigma, antagonize the actions of strychnine in a part of the sphere of its influence. They do not antagonize its toxic action. Chloral, tobacco, bromide of potassium, ether, and chloroform (inhaled), are its true physiological antagonists.

In cases of poisoning, tannin and the vegetables containing it should be freely administered, for the tannate of strychnine is very insoluble. Emetics, or the stomach-pump, must be used promptly. The tetanic spasms are best controlled by chloral and the inhalation of ether, or by tobacco, or by the bromide of potassium in very large doses (ʒ ij—℥ ss). The maintenance of artificial respiration has a decided effect in postponing in animals as in man the lethal action of strychnine.

Strychnine should not be combined with bromides, chlorides, and iodides, in the same solution. Accidents have happened by taking the last portion, which will contain all of the strychnine, precipitated as hydrobromate, hydriodate, etc.

Synergists.—Brucine, picrotoxine, thebaine, ergot, and, according to my own experimental investigations, belladonna, electricity, cold, etc., promote the activity of nux-vomica and its alkaloids.

Physiological Effects.—The preparations of nux-vomica are extremely and persistently bitter. Like all bitters, they promote the flow of the stomach and intestinal juices, increase the digestive power, and thus favorably affect the appetite. They also hasten the intestinal movements, and the stools voided are somewhat relaxed.

The alkaloids of nux-vomica are very diffusible substances, and enter the blood very quickly. They lessen somewhat the oxidizing power of the blood, but this effect is quite insufficient to account for the physiological reactions produced in the nervous system. Small medicinal doses of nux-vomica and its alkaloid accomplish no more than other bitters, as respects the circulation. More or less plethora, slightly increased action of the heart, and, as a consequence of this condition of the vascular system, a greater energy in the performance of the various functions, result from their administration.

When a lethal dose of nux-vomica, or of its alkaloid, has been taken, characteristic symptoms follow in a few minutes. The state of the stomach as to food, the presence of tannic acid in the food, and of fat, probably; also the condition of the blood-vessels, influence the rate of absorption, and symptoms may begin in a few minutes or be delayed an hour or even longer. When a full medicinal dose has been taken, some slight shuddering, a sense of constriction of the fauces and jaws, sudden pains like electric shocks passing through the limbs, startings of some of the voluntary muscles, dilated pupils, "a meaningless smile," paleness of the face, followed by flushing and increased warmth of the surface and perspiration, are symptoms which may be produced without further development of a toxic action. If the dose be large enough to cause death, the above-described symptoms are quickly followed by tetanic convulsions, in which nearly all the voluntary muscles are engaged. When the paroxysm occurs, a shudder passes through the whole frame; the head and extremities jerk and twitch, and then suddenly a general tonic convulsion takes place —the limbs are extended, the hands clinched, the toes and feet incurvated, the head bent backward, the body arched and rigid, the abdominal muscles hard and tense, the respiratory muscles fixed so that the body, curved in the form of a bow, rests on the occiput and heels. The countenance assumes a ghastly grin—the *risus sardonicus*; the arrest of the respiratory movements suspends oxidation of the blood, and the skin becomes cyanosed; strong erections of the penis occur, and frequently involuntary evacuations of semen, urine, and fæces take place. Rarely does death ensue in the first paroxysm; the spasm relaxes, and nothing remains of the attack but the muscular soreness and fatigue, and the sense of impending dissolution. Absolute quiet retards the paroxysms. At first the senses are preternaturally acute, and, as the reflex function is abnormally excitable, the slightest peripheral irritation suffices to bring on the spasms. Generally patients experience comfort when the limbs are strongly held, or even rubbed, during the paroxysms; but, in the interval, absolute quiet is most grateful. The mind remains unaffected until the close, or, at least, until carbonic-acid poisoning sets in. The paroxysms rapidly succeed each other, and increase in duration and severity, death occurring usually by fixation of the muscles of respiration, or by exhaustion, and within two hours, as a rule, from the beginning of symptoms.

The remarkable similarity in the symptomatology of traumatic tetanus and strychnine tetanus requires that the points of difference between them be clearly set forth. In strychnine tetanus the jaw-muscles are not first thrown into spasm, and are not always rigid during the paroxysm ; in traumatic tetanus, trismus is one of the first symptoms. In strychnine tetanus, after the convulsion, lasting from a half to one or two minutes, there is usually complete relaxation ; in traumatic tetanus rigidity of the affected muscles continues. A case of strychnine tetanus goes on rapidly increasing in severity, and lasts from a few minutes to two hours ; a case of traumatic tetanus proceeds more slowly, and lasts always a number of hours, and may extend over days and even weeks. And, lastly, in traumatic tetanus, the capital symptom of a wound or injury exists.

No very characteristic *post-mortem* appearances result from strychnine-poisoning. The muscles, at first relaxed, become rigid, the feet turned in, the fingers clinched, or the body may maintain the position of opisthotonos, in which it was at the moment of death. Congestion of the cerebral and spinal meninges is usually observed, and Schroeder Van der Kolk first ascertained that dilatation of the vessels and sanguineous extravasations are found in the gray matter of the cord (medulla oblongata), and this observation has since been repeatedly confirmed.

The smallest quantity of strychnine which has produced a fatal result in an adult was a half-grain. Rarely can one twelfth of a grain be given without causing muscular twitchings, and one sixteenth of a grain has caused death in a child of between two and three years.

The effects of strychnine are exerted on the spinal cord, on the seat of the motor functions. It does not affect the functions of the motor nerves directly—the irritability of the motor nerves is not destroyed by strychnine, it is exhausted by over-stimulation. The sensory nerves are either unaffected, or their irritability is exhausted. The reflex functions of the spinal cord are exalted. The afferent nerves, while preserving their irritability, communicate impressions to the reflex centers, motor impulses are quickly originated, and the muscles through the motor nerves are fixed in a state of tonic contraction. The over-stimulation of the cord and the motor nerves exhausts the irritability of the latter. The muscles preserve their contractility.

The effects of strychnine are not limited to the nervous system of animal life : the organic nervous system participates in the perturbation. The dilatation of the pupil, the erection of the hair-follicles, the *tinnitus*, the increased heat in the limbs, and the perspiration which are produced when strychnine is injected subcutaneously, indicate an influence on the sympathetic system similar in kind to that exerted on the voluntary. Experimental investigations have confirmed these clinical observations. A very considerable rise in the arterial pressure, contraction of the vessels in the frog's web, and increased action of the heart, have been experimentally demonstrated to be caused by strychnine (Sigmund Mayer).

Magendie, who made the first study of the actions of strychnine, found that, by previously destroying the spinal cord, no convulsions followed the administration of a poisonous dose. The precise agency of the cord is disputed, but it is in a high degree probable that the condition is one of exaggerated reflex excitability, so that the smallest possible peripheric irritation induces a response in the reflex motor center. When Setschenow's inhibiting center of reflex movements is withdrawn as in the decapitated frog, the spasms are induced as before. The passage over the face of the faintest current of air, even the mental conception of such an impression, will excite the spasms. Absolute repose, as by placing the poisoned frog under a bell-glass, the table firm so that no jar can reach the animal, and light excluded, has a decided effect in preventing attacks. If a poisoned human subject is similarly protected, the convulsions are diminished in violence. Again, if, when the convulsions are impending, the limbs are firmly grasped and held, the force of the spasm is lessened thereby. The medicines most effective in affording relief are those which lower the activity of the reflex function—notably chloral, bromide of potassium, etc. These facts indicate that an exaltation of the reflex function of the spinal cord is caused by strychnine. But this is probably not alone sufficient: irritation of the motor cells is also a factor (Spitzka). In opposition to the commonly accepted view, Falck maintains that strychnine acts primarily on the brain, or rather on the vaso-motor center of the brain, then on the inhibitory center for the heart, and the respiratory center, and lastly on the reflex apparatus of the cord. The spasms are the combined results of these actions.

Bernard held that the sensibility of the sensory nerves is destroyed by strychnine, but after the motor functions have ceased. Martin-Magron, and subsequently Vulpian, ascertained that the sensibility persists after motility has ceased. This contradiction of supposed facts has been examined more recently by Brauch, whose observations, if entitled to belief, support the statement of Bernard. Brauch has found that the toe of the poisoned frog may be crushed, and the central portion of the divided sciatic may be burned, without inducing spasms or reflex movements, when the slightest jar of the animal will cause strong convulsions. Kölliker and Vulpian, with many others, hold that the excitability of the motor nerves is so far impaired by strychnine that irritation of the nerve-trunk produces very feeble or no muscular contractions. The American observers [illegible] and [illegible] both maintain that the peripheral nerves are unaffected in strychnine poisoning. Martin-Magron et Buisson and Vulpian find that the action of strychnine is local on the nerves, and is therefore greatly influenced by the quantity of the poison reaching them. If the dose of strychnine is small, the motor and sensory nerves remain unimpaired ; but if the dose be large, their irritability is destroyed. The influence of the quantity administered is consequently very great, and is exhibited in other respects. Thus, while a merely lethal dose causes strong convulsions, a very large toxic dose will kill at once without any reflex disturbances. It is impossible, then, to make the distinction between motor and sensory nerves as respects the action of strychnine: it either destroys or spares the excitability of both.

While strychnine exalts the irritability of the reflex motor center, it stimulates the vaso-motor center or centers in the cord, with the result of greatly increasing the blood-pressure. This rise in blood-pressure is prevented by dividing the cord, according to Mayer, Klapp, and others, but, according to Schlesinger, not. Now, as it has been found by Richter, who has studied the circulation in transparent parts, by Mayer, and by Spitzka, that the arterioles strongly contract under the influence of strychnine, the blood-pressure must rise from this cause ; hence, the observation of Schlesinger is probably correct, that the blood-pressure rises in strychnine-poisoning, notwithstanding division of the cord. As has been tersely expressed by Spitzka, "its vaso-motor effect is to increase the blood-pressure and the rapidity of the blood-current by contracting the arterioles. This effect is independent of the central nervous system." The effects of strychnine on the heart differ in cold- and warm-blooded animals, according to most authorities, and decidedly, also, according to the size of the dose. On frogs, the diastolic pause is prolonged, and the force of the systole augmented, so that arrest of the heart's action may take place in tetanic rigidity. These results, Spitzka holds, are due to an action on the cardiac ganglia and on the pneumogastric. The previous observations of Heinemann, however, do not correspond, for he finds that these phenomena are produced after the vagi are divided. In warm-blooded animals the heart's action is accelerated, while the tension is raised. Klapp, however, finds that strychnine slows the pulse in the cat and rabbit, and that the retardation is due to an impression on the cardiac motor ganglia, and not to stimulation of the inhibition. He finds that the action is the same on both classes of animals. These contradictions are probably due to the difference in the dose employed. A large toxic dose of strychnine will paralyze, instead of stimulate, the vaso-motor center in the medulla, and thus prevent any rise of blood-pressure. A small, merely lethal dose will stimulate the cardiac ganglia, the pneumogastric, and the vaso-motor ganglia ; but a large toxic dose will slow the heart, paralyze the vagi and the accelerator apparatus, and depress the vaso-motor functions generally. In the course of annual experiments for class instruction, the author has constantly observed the difference in results due to the quantity administered.

From clinical observation, in the absence of any experimental evidence, strychnine has been ascertained to have a stimulating effect on the respiration. If the dose is less than sufficient to tetanize, the function of respiration is increased in energy and in depth. Hence, this agent antagonizes the respiratory poisons, as well as those morbid states which depress the respiratory function.

On the blood, the experiments of Harley show, strychnine has some action. Agitation of blood with the air, in the presence of strychnine, is followed by a less production of carbonic acid than if strychnine be not present, but such experiments are entitled to small consideration. Strychnine, as Hippel and Cohn have shown, stimulates the retina and increases the sharpness of definition and the area of the visual field. These facts explain the curative effects of strychnine in certain diseases of the retina.

Very peculiar phenomena have been observed by Spitzka as a result of chronic poisoning—an entirely new subject. It appears to be exceedingly difficult to keep animals alive, but Spitzka succeeded in maintaining five frogs in tetanus for over forty days. Symptoms occur under these circumstances quite distinct from those produced in acute poisoning by strychnine. Disease in the cord is set up, "partly as an insular sclerosis, partly as an hæmorrhagic or non-hæmorrhagic myelitis." These experiments demonstrate that, to maintain a constant effect by strychnine in the beginning, the dose must be increased, but later the quantity given may be decreased and administered at longer intervals. The importance of these observations from the therapeutical point of view is, indeed, great. The symptoms occurring from chronic poisoning are, as respects the spasms, a diminution of their energy, the development of an ataxic state, with tremors and pupillary myosis. These phenomena approach those produced by picrotoxin, and are intermediate between the effects of strychnine proper and of curara or methyl strychnium.

Therapy.—The tincture of nux-vomica is one of the numerous remedies proposed for the *vomiting of pregnancy*. It is best adapted, according to the author's observation, to those women who have a seasick feeling and who do not vomit much. Half a drop to a drop, in cherry-laurel water, or in simple water, every hour or two, is a suitable dose. Like all other remedies, nux-vomica often fails in this malady. Owing partly to its intense bitterness, and partly to its influence on the nervous system, the tincture of nux-vomica is an excellent stomachic tonic, adapted more especially to the treatment of those cases in which there is a neurotic element, as, for example, *atonic dyspepsia* and *gastralgia*. From five to ten drops three times a day before meals is a suitable dose in these cases. In *chronic gastric catarrh*, whether occurring as an independent affection, or as an accompaniment of other maladies, the tincture of nux-vomica is one of the most effective bitters. In the *gastric catarrh and morning vomiting of drunkards*, this remedy is next in value to arsenic. It may be given, advantageously, with mineral acids. The *poor appetite*, the *feeble digestion, and the nervousness and trembling*, which follow the sudden withdrawal of alcoholic stimulants, may be removed by frequent small doses of the tincture. To diminish the *craving for stimulants* when they are withdrawn, and *to sustain the nervous system*, the following combination is exceedingly effective: ℞ Tinct. capsici, ʒ vj; tinct. nucis vom., ʒ ij. M. Sig.: *Twenty drops in water every four hours. Intestinal indigestion and flatulence* are also removed by tincture of nux-vomica.

In *atonic diarrhœa*, nux-vomica is a serviceable addition to other remedies, when a paretic condition of the muscular layer of the bowel may be presumed to exist. It is, however, more especially in *constipation* that nux-vomica is useful. It is indicated in those cases in which there are inaction of the muscular layer and, consequently, great fecal accumulations. It may be most advantageously given with purgatives in such cases: ℞ Tinct. aloes et myrrhæ, ʒ vj; tinct. nucis vomicæ, ʒ ij. M. Sig.: *Fifteen to thirty drops two or three times a day.*

Nux-vomica has been signally useful in some forms of *epidemic dysentery*. It is indicated when there is depression of the vital forces, the intestines distended with gas, the stools like prune-juice. In some epidemics of *cholera*, strychnine, combined with mineral acids and opium, has appeared to be effective when the patient was about to pass into the state of collapse; and it has also been used as a prophylactic during the preliminary diarrhœa: ℞ Strychninæ sulphat., gr. ¼; acid. sulphuric. dil., ℥ ss; morphinæ sulphat., gr. ij; aquæ camphoræ, ℥ iijss. M. Sig.: *A teaspoonful every hour or two, well diluted.* This combination is also effective in *summer diarrhœa*, when the evacuations are very watery, and in *colliquative diarrhœa*. When there is much pain, the quantity of morphine may be increased, or the first dose may be doubled. When the character of the case is such as to require continued use of the prescription, of course, the quantum of strychnine must be lessened.

Nux-vomica and its alkaloid strychnine are much used in combination with restorative remedies, in cases of impoverished blood—in *anæmia, chlorosis, hæmorrhagic diathesis, purpura*, etc. In anæmia and chlorosis strychnine is used with reference to its power to stimulate the blood-making organs, which functionate under some special influence proceeding from the nervous system. ℞ Ferri sulph. exsic., ℈ij; quininæ sulph., ℈j; strychninæ sulph., gr. ss. M. Ft. pil. no.

xx. Sig.: *One pill three times a day.* No prescription is more generally useful in these states than the sirup or elixir of iron, quinine, and strychnine, a formula originally proposed by Aitken.

In the treatment of *amenorrhœa*, the preparations of nux-vomica and strychnine frequently enter into the composition of prescriptions. In *post-partum hæmorrhage*, Fordyce Barker prescribes the tincture of nux-vomica (twenty drops), and fluid extract of ergot (thirty drops), "every half-hour until well assured that the uterus is well contracted." It is obvious that not more "than two or three doses" of such strength will be safe. The neuralgic form of *dysmenorrhœa* may be permanently removed by nux-vomica given during the interval.

When *impotence* is due to mere relaxation and atony of the erectile apparatus, and is not dependent on organic defects, the preparations of nux-vomica are indicated and are useful. *Incontinence of urine*, when due to a paralytic state of the sphincter, may sometimes be cured by strychnine. *Nocturnal incontinence*, which is most successfully treated by belladonna, ergot, and iodide of iron, is sometimes not relieved by these agents, when strychnine may be tried. The author can not state with precision the cases in which it succeeds, but it has appeared to him most successful in those cases dependent on simple atony of the bladder, associated with general laxity of fiber.

The most important uses of nux-vomica and its alkaloid are in the treatment of nervous affections, chiefly in *paralysis*. It may be used with advantage in *hemiplegia*, when sufficient time has elapsed to permit repair of the damage done by the extravasation. It is improper to use strychnine during the period of "early rigidity," and it is without avail in cases of "late rigidity" of the paralyzed members. It is most useful when the paralyzed members are completely relaxed. It is useless when the paralysis has existed so long that the muscles have undergone fatty degeneration, so that they no longer respond to a faradic or slowly-interrupted galvanic current. Even if the necessary conditions as respects the state of the muscles are present, strychnine is inadmissible in cases of paralysis of cerebral origin when there are vertigo, headache, and *tinnitus*.

In *paraplegia of reflex origin*, in *rheumatismal paraplegia*, in *syphiloma of the spinal meninges*, paraplegia continuing after the removal of the deposits, strychnine is a most serviceable remedy.

The best results are obtained from the use of strychnine in *local paralysis, in lead-colic and constipation, and in drop-wrist, in mercurial and paludal palsies, in rheumatismal paralyses*—for example, *facial paralysis*, from exposure of the face to cold—*torticollis, spinal curvature, from paresis of the muscles on one side*, etc.

In certain forms of spasms strychnine sometimes achieves most important results. The evidence which has been accumulated as to the curative power of strychnine in *tetanus* would be very conclusive if it were worthy of credence, which seems to the author doubtful. In this disease it should be given so as to substitute the strychnic for the traumatic tetanus, but the symptoms induced should not exceed those due to a *full medicinal dose.* Strychnine is most successful—as indeed are all the appropriate remedies—in the more chronic cases of tetanus, and in those of spontaneous rather than traumatic origin.

Trousseau's experience is strongly in favor of the use of *strychnine* in the treatment of *chorea.* The method which he has pursued does not commend itself—it is heroic, and indeed unsafe. It consists in the use of such doses, beginning with one dose a day and increasing them, until stiffness of the muscles of the neck, spasmodic jerkings, and a "meaningless smile," indicate the beginning of strychnic poisoning.

Strychnine is a very serviceable remedy in *idiopathic* or *essential epilepsy.* It is adapted to pale, anæmic young subjects who have the *petit mal*, as well as the *grand mal*, and whose attacks are nocturnal. It exerts no influence but an injurious one over symptomatic epilepsy—that dependent on "coarse organic lesions of the brain." It is said that the state of the retinal circulation furnishes an indication for strychnine or bromide of potassium, fullness of the retinal vessels being an indication for the latter agent, and pallor and anæmia for the former.

In that functional irritability of the nervous system manifested by restlessness and *wandering neuralgic pains*, strychnine affords relief.

Spasmodic asthma of nervous subjects, when the paroxysms are due to an irritable state of the nervous system, are associated with vague neuralgic pains, and are determined by psychical influences, may be so far influenced by the persistent use of strychnine as to occur much less frequently.

Amaurosis of a functional kind, from lead, tobacco, and alcohol, may be cured by strychnine. Paralysis of the ocular muscles (prosopalgia), of the muscle of accommodation, and paralysis of a single muscle, when these affections are due to an arrest of function of the nerve or nerves, and do not involve changes of structure, are curable by strychnine. Nagel, however, reports a cure of amaurosis in which there existed white atrophy of the optic disks!

Holtenhof points out the kind of amblyopia most benefited by this treatment. The cases without serious lesion, those dependent on anæmia, on a reflex effect from some part of the trigeminus or sympathetic, or due to the abuse of tobacco and alcohol, are especially amenable to the strychnic treatment. "In central amblyopia," says Holtenhof, "without lesion of the macula and with decoloration of the temporal portion of the optic disk, I have obtained remarkable improvement by the use of strychnine." Again, when there are lesions resulting from the deep-seated inflammation of the membranes, improvement may be hoped for when the primary inflammation has ceased and the consecutive atrophy is stationary. In *retinitis pigmentosa* the results produced by strichnine are very striking. In five cases the diurnal dimness of vision and the nocturnal blindness were relieved considerably, in four cases there ensued an augmentation in the acuity of vision, and in two the visual field for white light was enlarged. Holtenhof finds strychnine inferior to electricity in the treatment of paralysis of the ocular muscles.

Strychnine has remarkable powers as a respiratory stimulant. Since the introduction of Aitken's formula for the phosphate of iron, quinine, and strychnine, the fact of its utility in *chronic bronchitis, incipient phthisis, dilated bronchi*, etc., has been distinctly recognized. The good effects of this combination are due chiefly to the strychnine. We possess no remedy more generally effective in the *vomiting of phthisis* than strychnine. This vomiting is reflex mainly, and occurs at the termination of a paroxysm of coughing, but there is also more or less stomachal indigestion. As the stomach is emptied, the vomiting interferes with nutrition. Strychnine has also, as Murrell has shown, some power to lessen the *sweating of phthisis*. This agent may, therefore, be regarded as an important remedy in consumption. There are several modes of administration, but the best is by solution, the alkaloid dissolved in water with a mineral acid: ℞ Strychninæ, gr. j; acid. muriatic. dil., ℥ j. M. Sig.: Five to ten drops in water three times a day.

Strychnine is one of the *antidotes to chloral*, as was first shown by Liebreich, but it is not the chief. It may be utilized cautiously as one of the means of counteracting the respiratory and cardiac depression, but it should not be depended on wholly.

Nux-vomica has been used with success in the treatment of *intermittents*. At present it is rather employed as an adjuvant to quinine, than relied on as the sole curative agent.

Hypodermatic Injection of Strychnine.—This important therapeutical measure needs to be separately discussed. The solution which the author advises is as follows: ℞ Strychninæ sulphat., gr. j; aquæ destil. vel aquæ lauro-cerasi, ℥ j. M. Sig.: *Ten minims contain one-forty-eighth of a grain.* Some heat is usually necessary to procure a perfect solution.

"The effects of strychnine," as has been well remarked (Echeverria), "are widely different when administered hypodermically or by the mouth. By the latter method the quantity may be repeated and increased, unsuccessfully, . . . and yet a smaller dose of the substance, exhibited hypodermically, be capable of regenerating at once the lost muscular power."

The indications for the subcutaneous use of strychnine are precisely as those given above for its stomach administration: it is contraindicated in cases of hemiplegia when the injury to the brain has been recent. It generally does no good, but harm, when the paralyzed muscles are rigid. It is most useful in old cases of hemiplegia, the subjects not being advanced in life, the paralysis incomplete, the muscles flaccid but not wasted, and having preserved their electro-contractility. Very remarkable improvement not unfrequently follows from this mode of treatment in suitable cases.

The hypodermatic injection of strychnine sometimes is entirely successful in curing *paraplegia*, but the limits of its utility are well defined. It is not proper, and is in every way injurious, in acute cases involving structural alterations of the spinal cord. In doubtful cases, a strychnine injection may be used as a means of diagnosis between structural and functional diseases of the cord: in the former, the symptoms are increased in definition; in the latter, they are ameliorated by the injection. This mode of using strychnine is curative in *reflex paraplegia*, in *paraplegia due to anæmia of the cord*, in *hysterical paraplegia*, and in those cases of paresis of the muscles of the inferior extremities due to concussion of the cord, to rheumatism of the meninges, and to syphiloma, after the local morbid process has ceased.

In *infantile paralysis*, the hypodermatic injection of strychnine is an important addition to other means of treatment. If the electro-contractility of the affected muscles is not lost, very beneficial results may be expected: the injection promotes the capillary circulation, and increases the growth and power of the muscles.

In no form of paralysis is the use of strychnine more conspicuous for good than in *diphtheritic paralysis*. Few cases are not promptly benefited and most are quickly cured. The utility of the subcutaneous injection of strychnine has been most signally exhibited in the *local paralyses;* e. g., *facial paralysis, aphonia from paralysis of the vocal cords; paralysis of the extensors by lead; paralysis of the sphincter vesicæ, of the sphincter ani*, etc.

The mode of practicing the injection is of considerable importance. The solution should be thrown into the substance of the paralyzed muscles. For example, in hemiplegia, the muscles in turn, of the paralyzed side, should be pierced by the needle, and the solution discharged into them. In drop-wrist the extensors should be grasped, made tense, and the needle of the syringe be thrust well into them. In paralysis of the sphincter ani and prolapse of the bowel, the muscle affected should be penetrated by the needle. When the affected muscles are beyond reach, the injection may be practiced at any indifferent point.

Next to the treatment of paralyses, the most frequent application of strychnine by the hypodermatic method is in certain ocular maladies. In the normal condition, strychnine affects the visual functions. Hippel first studied these effects, afterward Sandi and Cohn, and subsequently, in France, Coumétou and Rouire. According to Coumétou, strychnine augments the excitability of the retinal elements, increasing the sharpness of vision, central and peripheral, and also enlarging the visual field. He advises its use in *amblyopia* without lesions, dependent on functional disorder of the retina, and says it may also, if the lesions are not too far advanced, effect favorable changes in chronic diseases of the optic nerve and retina. Rouire also agrees with previous observers in stating that strychnine affects the optic nerve-fibers, increasing the normal acuity of vision and enlarging the visual field. He advocates its use in *tabetic atrophy*, and calls attention to the fact that in certain atrophies good results are obtained only by a progressive increase in the amount administered. In these ocular maladies the solution may be injected in the temple, or in the nape of the neck, taking the usual precautions against accident.

In *infra-orbital neuralgia*, good results have been obtained from the subcutaneous injection of strychnine. This practice may be very useful in *neuralgia* characterized by anæmia and depression. It may also be highly serviceable in *epilepsy*, the cases selected according to the rules already defined.

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Ignatia.—Ignatia. The seed of *Strychnos Ignatii* Bergius (Nat. Ord. *Loganiaceæ*). St. Ignatius's bean; *Fève de Saint-Ignace*, Fr.; *Ignazbohnen*, Ger. (Not official.)

Tinctura Ignatiæ.—Tincture of ignatia (10 parts of ignatia to 100 parts of menstruum). Dose, ♏ ij—♏ x.

COMPOSITION.—Ignatia has the same composition as nux-vomica, but yields relatively larger proportions of the alkaloids *strychnine* and *brucine.* These principles exist in the bean in combination with *igasuric acid.* Formerly, the bean of St. Ignatius was the principal source of commercial strychnine, but the abundance and low price of nux-vomica now compensate for the difference in strength. The preparations of ignatia are stronger than the corresponding ones of nux-vomica.

ANTAGONISTS, INCOMPATIBLES, and SYNERGISTS are the same as for nux-vomica.

ACTIONS AND USES.—Ignatia, containing the same principles as nux-vomica, must have the same physiological actions and corresponding therapeutical properties.

The tincture of ignatia, the most useful preparation, has a powerful and persistent bitter taste, and, in common with bitters, has the effect known as stomachic tonic. It is a very effective stimulant of the gastric mucous membrane, promotes the flow of gastric juice, and hence increases the activity of the stomach digestion, and may therefore be used with advantage in *atonic dyspepsia*, and in the *nausea* and *vomiting* of gastric and cerebral anæmia. It is also often highly serviceable in the *gastralgia* of nervous women having impoverished blood. The *migraine* or *sick-headache* of such subjects, also, may be relieved by ignatia. It may be very useful in the various disturbances belonging to *chronic gastric catarrh*, but it is contraindicated in all acute inflammatory affections. It is in these stomachal affections more especially that ignatia is preferred to nux-vomica by many practitioners.

Ignatia affects the nervous system of animal life in the same way, but more energetically in the same dose, that nux-vomica does. It exalts in the same way the reflex function of the spinal cord, and similarly arrests respiration by a tetanic fixation of the respiratory muscles. It is, however, not used in affections of the nervous system, the alkaloid strychnine being now universally employed.

Cocculus.—The fruit of *Anamirta cocculus*, or *Cocculus Indicus* (Not official.)

There are no official preparations except picrotoxin, the active principle. A saturated tincture may be used. Dose, ♏ ij—♏ xv. A fluid extract can be made, and is a useful form for administration. Dose, ♏ ij—♏ x, gradually increased.

Composition.—The effects of cocculus are due chiefly to the presence in it of a peculiar neutral principle known as *picrotoxin*. This has been admitted to the Pharmacopœia, and is therefore official.

Picrotoxinum—picrotoxin—is not an alkaloid, although allied to this group of substances. It does not combine with acids to form salts. It is neutral, crystallizable, forming needle-shaped, stellar, or foliaceous crystals. It is soluble in 240 parts of cold and 25 parts of warm water, and in alcohol, and dissolves freely in alkaline solutions. It is unaffected in solution by the metallic salts, tannin, etc., and is not precipitated by the tests for the alkaloids. It may be administered in pill-form, and can be combined with any of the usual so-called nervine tonics. Picrotoxin may be administered subcutaneously, in solution in water—one grain to ℥ ss—the dose ranging from $\frac{1}{60}$ of a grain to $\frac{1}{40}$ of a grain. By the stomach it may be given in from $\frac{1}{80}$ of a grain to $\frac{1}{20}$.

Antagonists.—The carefully-conducted researches of Browne show that chloral is its physiological antagonist in rabbits and Guinea-pigs, and probably will prove to be of value in cases of poisoning in man. The anæsthetics, and the motor depressants in general, are antagonistic in respect to its power to produce spasm.

Synergists.—All the remedies of this group, notably strychnine, brucine, and ergot, increase the effects of picrotoxin.

Physiological Actions.—The taste of picrotoxin is bitter. It increases the flow of saliva. In what form soever administered, more or less nausea is produced, when the quantity given is sufficient to cause cerebral effects. It is not an irritant to the gastro-intestinal mucous membrane; it increases secretion, and promotes peristalsis, but no hyperæmia of the mucous membrane has been observed after death from a toxic dose. The secretions of the glandular appendages of the mucous membrane, probably also of the pancreas and liver, are decidedly increased, the stools becoming soft and more copious. Administered at any point, picrotoxin diffuses readily into the blood, but nothing is known at present of the changes which it induces, if any, in the composition of the blood. After death the right side of the heart is distended, and the left side incompletely emptied and flaccid. The action of the heart varies with the stage of the effects, and doubtless also more or less according to the size of the dose. At first the cardiac movements are slowed, the arterial tension somewhat elevated; during the convulsions the action grows rapid, but, succeeding the convulsions, and during the stage of coma, the pulse becomes slow again. According to Planat, by small doses, the cardiac pulsations are slowed before the convulsions come on; then the muscular excitement induces rapid action, to be succeeded again by the retarding effects of the remedy, increased by the coma. Roeber also finds that the cardiac contractions are retarded, and the walls of the heart dilated and flaccid. The respiration is also accelerated, and there occurs strong inspiratory dilatation, because of spasm of the glottis—effects which are due to stimulation of the pulmonary portion of the vagus, and which cease on division of this nerve (Roeber). When the convulsions cease, the respiration becomes slower and more shallow. No engorgement of the lungs is found after death (Browne).

The pupils are not specifically affected. During the convulsions they dilate somewhat, when the tonic spasms come on, and contract again during the clonic spasms. The fundus of the eye, examined by the ophthalmoscope, exhibits considerable hyperæmia.

The cerebral effects of picrotoxin are variously interpreted. Drowsiness, stupor, some muscular trembling, are observed in cold- and warm-blooded animals, and have also been experienced in man. A heavy, stupid intoxication, with vertigo, inco-ordination, and diminished sensibility, followed by after-headache, depression, and nausea, are symptoms ascribed to the action of cocculus Indicus in beer sophisticated by this drug. Restlessness, unsteady gait, and weakness of the hind extremities, also precede the convulsions in animals. Twitching of the ears, shaking of the head, and spasms in the eyelids, eyebrows, lips, and fore-paws, now come on. Then follows a distinct tonic convulsive stage, with opisthotonos, or emprosthotonos, tetanic fixation of the muscles of respiration, cyanosis, and stertor. This tetanic stage is succeeded by the general clonic convulsions, and the seizure is terminated by a temporary paralysis and coma. In the order and succession and character of phenomena, a remarkable similarity in the actions of picrotoxin to the epileptic paroxysm must be discerned. By Roeber the convulsions are referred to the effects of the poison on the medulla. He finds that, after destruction of the brain, the symptoms are the same as before; after destruction of the optic lobes, the convulsions are less violent; but when the medulla is removed the convulsions do not occur, and a large dose causes coma only. These facts indicate that picrotoxin acts on the spasm and vagus centers in the medulla, and on Setschenow's inhibitory center. Planat, Chirone, and Testa, also hold that this agent acts on the cerebellum, medulla, and spinal cord, and leaves the brain exempt. Against these opinions we have the carefully-considered but still hypothetical view of Browne, who finds in Ferrier's cortical centers the real seat of the action of picrotoxin. That the center, and not the periphery, is the place where the action of the poison is expended, seems proved by the studies of Roeber, who finds that the electrical reactions of nerve and muscle remain unaltered.

The action of the heart is arrested in the diastole, and, while the cavities are full, the capillaries at the periphery are empty. The vascular lesions, *post mortem*, are similar to those of epilepsy. That some of the poison is yet in the blood, is proved by the fact that flies eating it are poisoned. Elimination probably takes place by the various channels of excretion, but chiefly by the kidneys. The skin is powerfully acted on, and hence picrotoxin ranks among the most active diaphoretics. The urinary excretion is also increased, but more exact observations are needed on these points.

Therapy.—Picrotoxin will, probably, be found very useful in cases of *torpor of the intestines*, dependent on deficient secretion and paresis of the muscular layer. In the *night-sweats* of consumption it has been used with great success by Murrell, who had but one failure in twenty cases. He finds that it is best to give the necessary dose at night—from $\frac{1}{180}$ grain to $\frac{1}{60}$. The effect lasts about ten days, when the sweating begins again, and the remedy must be repeated. Picrotoxin has been used with success in the treatment of *epilepsy* by Planat, Dujardin-Beaumetz, Hurd, and by Hammond. It is more especially adapted to the weak and anæmic type. It has been also used with success in *chorea*, and with promising results in *paralysis agitans*. In a case of *glosso-labio-laryngeal paralysis* Gubler obtained a notable amelioration. Further experiences with these diseases are much needed. It is probable that this remedy may be applied with advantage to the treatment of other paralyses. According to *Tschudi*, it has been given in *paralysis of the sphincters* with good results. The *tremors of chronic alcoholism* have, it is said, been removed by it. One of the forms of *sick-headache*—that occurring at or about the menstrual period—is sometimes greatly relieved by its timely exhibition. An ointment of picrotoxin—ten grains to an ounce of simple ointment—has been applied with success to the treatment of *parasitic skin-affections*. Care is necessary, and abraded surfaces must be avoided.

A saturated tincture of cocculus Indicus might be employed in place of picrotoxin. Planat recommends a tincture composed of one part of the berries to four parts of alcohol, and of this one drop is the initial dose, morning and evening, increased daily by the addition of two drops, up to sixty or seventy drops for an adult, daily. In the diseases for which it is prescribed, it is necessary, to secure curative effects, that the physiological action be produced. Planat has used this tincture successfully in chorea, epilepsy, eclampsia (infantile), and in painful contractures of the extremities. Gubler advises the dose of a millegramme of picrotoxin for subcutaneous use. He has observed that indurated spots result from the injections, but they slowly disappear.

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Ergota.—Ergot. The sclerotium of *Claviceps purpurea*, replacing the grain of *Secale cereale* Linné (Nat. Ord. *Gramineæ*). *Ergot de seigle*, Fr.; *Mutterkorn*, Ger.

Extractum Ergotæ Fluidum.—Fluid extract of ergot. Dose, ʒ ss — ʒ j.

Vinum Ergotæ.—Wine of ergot. Dose, ʒ j— ℥ ss.

Ergotin.—This preparation must not be confounded with a constituent of ergot, supposed to be an active principle. The ergotin of the shops gets its name from "Bonjean's ergotin." It varies very much in strength, owing to faulty modes of preparing it, and is not unfrequently inert. As prepared by Squibb it is entirely soluble in water, and represents the powers of the drug. Ergotin (the aqueous extract) is the most eligible preparation for hypodermatic injection. From one to five grains may be injected at one time. In preparing it for this purpose, the quantity to be injected should be rubbed up with fresh distilled or rain water, and then passed through the filter. It is always better to prepare it whenever required. If it is necessary to preserve the solution, the addition of a little carbolic acid—one grain to four ounces—will usually suffice. The addition of glycerin is not necessary, except as a preservative fluid; and is objectionable, because it greatly increases the pain which attends the subcutaneous injection.

COMPOSITION.—Some confusion yet exists in regard to the constituents of ergot, notwithstanding recent advances in our knowledge. An unfortunate nomenclature is in part responsible for the confusion; but the subject is difficult, and the views of chemists have differed much.

Ergot contains about thirty per cent of a saponifiable, non-drying oil, with which is associated a small quantity of resin and cholesterin. When extract of ergot is treated with an alkali, a peculiar fishy odor is developed, due to *methylamine*, according to some authorities, and *trimethylamine* according to others. Ergot also contains lactic and phosphoric acids and phosphates. The two principles, *ecbolina* and *ergotina*, separated by Wenzell in 1864, are not true alkaloids of ergot, and are said by Dragendorff to be identical. In 1830 a supposed alkaloid was obtained by Wiggers, which he named *ergotin*, but this is not the true active principle. Unfortunately, an aqueous extract, prepared by Bonjean, was also named *ergotin*. Köhler has examined the ergotin of Wiggers and that of Bonjean, and finds that they are mixtures: the former containing the ingredients of ergot not soluble in water; the latter, those that are soluble in water. According to Köhler, neither of these so-called ergotins represents the properties of ergot. More recently Dragendorff and Podwissotzky have gone over the chemistry of ergot anew, with different results. They have introduced new terms also, which add to the complications. The most important principles obtained by them are *sclerotic* or *sclerotinic acid*, and *scleromucin*, the former existing in good ergot in the proportion of about four per cent, and the latter two to three per cent. Another alkaloid has lately been discovered by Tanret, to which he has given the name *ergotinine*. This substance seems to be a genuine alkaloid; but Kobert has proved that it is inert, or, at least, has no action on the uterus. It is a white, crystallizable solid, insoluble in water, and soluble in ether and chloroform. It is alkaline in reaction and has strong basic properties, and combines with acids to form salts. It is an unstable substance, and in the air soon decomposes. The investigations of Kobert, made in Schmiedeberg's laboratory and published last year, have all the authority which the brilliant talents of the disciple and the immense knowledge of the great master can confer on any production. Kobert's study of the chemistry of ergot resulted in the separation of two acids, *ergotinic acid* and *sphacelinic acid*, and an alkaloid, *cornutine*.

Ergotinic acid is the principal part of the sclerotic acid of Dragendorff and Podwissotzky, mentioned above, and of Bonjean's *ergotin*. It has no effect on the uterus, but does act on the circulation in a manner unfavorable to the general purposes of the remedy. Sphacelinic acid is the most actively toxic, and is the principle that produces the ergot-gangrene. According to Recklinghausen, who made a careful investigation of the pathological state induced by it, the initial change takes place in the hyaline tissue of the intima of the blood-vessels; the lumen of the vessels is encroached on, thromboses form, and extravasations of blood occur in various places. Hyaline degeneration occurs in the lens, also, and cataract is thus formed. These effects are increased by the stimulation of the muscular fiber of the arterioles lessening their caliber, and thus raising the general blood-pressure. It acts on the uterus powerfully, and is an abortifacient. *Cornutine*, the alkaloid, is contained in ergot in minute quantity. It causes tonic and clonic convulsions, and death is due to paralysis of respiration. The *ecbolin* of Wenzell contains more or less cornutine, and owes to it any active property that it may exhibit. Tanret's crystallizable ergotinine is not cornutine; but if any given specimen proves to have active property, Kobert supposes it to contain cornutine.

The most eligible preparation of ergot, Kobert asserts, is an extract so prepared as to contain the sphacelinic acid and cornutine, and for which he proposes the name *extractum cornuti secalis cornutino-sphacelinicum Koberti*. Thus far this preparation, which is to be put forth by Gehe, of Dresden, awaits the new crop of ergot.

The composition of ergot has been so nearly arrived at that it will require but little additional investigation to decide finally. Meanwhile, the practitioner can obtain the best results from the fluid extract of the U. S. Pharmacopœia, if honestly prepared from fresh and genuine ergot.

The symptoms by which the physician may recognize the effects of the ergot administered, in any case requiring the exhibition of massive doses, are partly subjective. The patient experiences more or less headache, with a sense of constriction of the forehead, singing in the ears, and a vertigo, which consists in a sensation of floating off. The pupils dilate, and are rather sluggish in their response to stimulation; the eyes appear suffused, and are sensitive to light; the sense of hearing becomes abnormally acute, and loud sounds make a painful impression. The action of the heart is slowed, but the pulse is not tense, and the respirations are slower, with something of a sighing superadded. To this complex of symptoms must be added a feeling of anxiety, and a restlessness which is apparently due to the sensation of "fidgets," as it is commonly known—a feeling of unrest, which impels to constant movement of the limbs. As the effects increase, nausea comes on, and with it vomiting, that takes place suddenly, with little or no warning, the nausea and vomiting almost coincident. This cerebral vomiting is to be distinguished from that which is attendant on the gastro-enteritis of cases of poisoning.

Antagonists and Incompatibles.—The caustic alkalies and the metallic salts are chemically incompatible. Aconite, veratrum viride, tobacco, lobelia, and amyl nitrite (Shafer), antagonize the action of ergot on the circulation.

Synergists.—Electricity, cold, digitalis, belladonna, are synergistic as regards the vascular system. Savin, gossypium, rue, borax, increase its parturient action.

Physiological Effects.—In small medicinal doses ergot does not produce sensible physiological effects. In large doses it causes symptoms referable to the gastro-intestinal canal, and to the cerebro-spinal axis. It is bitter to the taste, and excites more or less heat and dryness of the throat, followed by thirst, stomach-pain, vomiting, intestinal pain, and occasionally purging. These gastro-intestinal symptoms are unquestionably due to the local irritant action of the drug; for, after death, in a few fatal cases which have resulted from its administration, there have been found patches of inflammatory redness in the stomach and intestines.

The active constituents of ergot diffuse into the blood. What changes, if any, are caused in the composition of the blood, are at present quite unknown. Very characteristic effects are, however, produced in the circulatory system: the action of the heart becomes slower, and an enormous rise takes place in the blood-pressure. This influence on the circulatory system modern research has shown to be due to the action of ergot on the vaso-motor nervous system; it increases the action of this system, and causes a contraction of the arterioles.

The dilatation of the pupil which follows is another evidence of this action. Pain in the head (usually frontal), dimness of vision, giddiness, and stupor, are also produced by it. The action of ergot on unstriped muscular fiber is further shown in the contractions of the parturient womb, the arrest of hæmorrhage, and the difficulty of micturition, which follows its medicinal administration. The power of ergot to contract the arterioles has been repeatedly demonstrated in the web of the frog's foot.

The phenomena above described, due to the administration of large medicinal or toxic doses, are known as *acute ergotism*. The peculiar morbid effects of ergot, when used for a long period of time as food (diseased grain), are known as *chronic ergotism*, which exists in two forms, the *convulsive* and *gangrenous*. Generally the convulsive form begins by vertigo, disorders of vision, *tinnitus aurium*, numbness of the fingers and toes, and afterward of the integuments of the body. These symptoms are followed by tetanoid contractions of the fingers, of the forearms on the arms, and of the arms against the chest; of the toes on the palmar surface of the foot, of the leg on the thigh. The thoracic, abdominal, and diaphragm muscles are also tetanically contracted, and respiration becomes painful and difficult, and attacks occur similar to asthma. The intestinal muscles become affected by cramp, doubtless tetanoid in character, colics ensue, and diarrhœa; the uterus in pregnant females takes on action, and abortion may result. The pulse is small, action of heart slow, and the surface cold. The appetite is generally ravenous.

The tetanic spasms, at first separated by distinct intervals, become continuous, and opisthotonos or emprosthotonos is produced. Anæsthesia (complete) of the surface succeeds to the tetanoid attacks, and gangrene of limited spots may occur. The organs of sense lose their sensibility and taste, hearing and smell are abolished. The pupils are dilated, sometimes unequal, and various disturbances of vision ensue. Epileptiform convulsions may occur in addition to the tetanoid spasms, delirium sets in, and complete insensibility at last supervenes.

As has been shown by Lasègue and Tardieu, the gangrenous and convulsive forms of chronic ergotism are not separated by any well-marked pathological differences. The gangrenous form begins by tingling, numbness, formication, an insupportable sense of fatigue in the members, an earthy hue of the skin, coldness of the surface; nausea, vomiting, and diarrhœa, with intestinal cramps, then occur; muscular contractions take place; an eruption of vesicles filled with a dark ichorous fluid appears on one or more extremities, and gangrene, dry or moist, quickly destroys the toes, the legs, the nose, or other parts.

The phenomena of chronic ergotism are evidently due to two causes —to the dyscrasia which exists in the subjects of this malady, owing to insufficient food and bad hygienic surroundings, and to the action of the ergot of the diseased grain, in diminishing the blood-supply to the cerebro-spinal axis, to the vegetative organs, and to the skin and muscular system.

To this general sketch of the actions of ergot, it may be well to add some particulars of its most important physiological properties, and some observations on the actions of the recently discovered active principles. The most conspicuous effect of ergot, and that on which depends its therapeutical applications, is the influence which it exerts over the vascular apparatus. It is an undoubted fact, in respect to which all the investigators agree, that ergot diminishes the number and alters the character of the cardiac pulsations. The frog's heart may be arrested in the diastole by the intravenous injection of a full dose. By Rossbach and Wernich it was observed that a vermicular or peristaltic motion was given to the heart of frogs. The arrest of the heart's action is attributed by Eberty to stimulation of the vagus and a consequent increase of the inhibition. By Rossbach it is referred to an action on the cardiac muscle. It is in a high degree probable, however, that the slowing and depression of the cardiac functions is due to the action of ergot on the cardiac ganglia. To this may be opposed the observation of Willebrand, that the normal or hypertophied heart so contracts under the action of ergot that the difference in size is appreciable by percussion! There is no dispute in regard to the contraction of the arteries induced by ergot. It has been observed and measured by Wernich, Briesemann, and Holmes. The notion that ergot causes contraction of the arteries by stimulating the vaso-motor system and its muscular apparatus has long been entertained. An enormous rise in the blood-pressure has been stated to occur by Eberty, Köhler, and H. C. Wood, and their opinion was based on kymographic observations. Holmes, Hermann, and Wernich, on the other hand, maintain that the blood-pressure is actually reduced. Wernich shows that the veins are dilated, and that a great accumulation of blood takes place in them, while, at the same time, the arteries contract, not receiving from the slowly acting heart sufficient blood. The contraction of the arteries is not, therefore, an active contraction, as has been supposed, but a collapse, the result of deficient supply of blood, which has accumulated in the dilated veins. By the theory of vaso-motor stimulation, it was easy to explain the action of ergot on the muscular fiber of the uterus and intestinal canal. If, however, the blood-pressure falls after the administration of considerable doses, as Handelin, Brown-Séquard, and others affirm, and the arterial contraction is not active, how explain the uterine and intestinal action of ergot? This result is due to arterial anæmia (Wernich, Schlesinger, Mayer, etc.). It is now clearly established that active movements occur in the muscular fiber of the intestinal canal and uterus by inducing an arterial anæmia. According to this view, then, the active peristalsis and the uterine contractions which follow the exhibition of ergot are the result, not of a direct stimulation of the sympathetic system, but of the diminished cardiac energy, dilatation of the veins, and arterial anæmia.

The action of ergot is not limited to the vascular apparatus. The arterial anæmia which it induces may serve to explain the cerebral effects which follow its free administration in man, but, besides these, the functions of the spinal cord and peripheral nerves undergo changes. In frogs ergot induces paralysis, beginning in the hind extremities, and thence involving all parts, the circulation and respiration being the last to yield. In warm-blooded animals the same effects are produced, and, if the action continues, finally the cardiac and respiratory centers are paralyzed. By Zweifel these central effects are held to be the principal, and all others merely secondary. On the other hand, the depression in the motor and reflex functions of the cord may be explained by the arterial anæmia, which is an undisputed effect of ergot, how much soever the mechanism of its production may be disputed. Indeed, it must be admitted that the actions of ergot are still *sub judice*. The numerous and often diverse views which have been expressed may be in part explained by the character of the preparations. There can be no doubt that the active constituents are unstable, and hence the pharmaceutical products vary, not only in the degree, but decidedly also in the character, of the actions. In Köhler's investigation, in which he compared the ergotin of Wiggers and Bonjean, there were very wide differences between them. The ergotin of Bonjean—an aqueous extract—excites the vaso-motor center in the medulla and the cardiac inhibitory center, and very large doses paralyze the heart, the muscular tissue losing its excitability to galvanism. Wiggers's ergotin has no effect on the vascular apparatus. In these experiments of Köhler, with which Eberty was associated, the power of ergot to increase the blood-pressure is an important point. The attentive reader will observe that in these experiments the heart was paralyzed, and the irritability of its muscular tissue destroyed. Wiggers's ergotin causes cramps of the intestines, and violent inflammation of the gastro-intestinal mucous membrane, effects which never result from Bonjean's. Both kinds of ergotin lower the temperature, and both retard the respiration. Bonjean's ergotin diminishes the irritability of the peripheral motor nerves, and Wiggers's increases it. Both lessen the irritability of the sensory nerves. Köhler concludes that, when it is desired to slow the heart, contract the vessels, diminish reflex actions, and lessen temperature, the ergotin of Bonjean should be used.

The physiological action of sclerotinic acid has been carefully studied by Nikitin in Rossbach's laboratory. He starts out by affirming the identity of action between this principle and ergot. In frogs the reflex excitability of the spinal cord is reduced, then destroyed, but in warm-blooded animals it is reduced only. It does not affect the irritability of the motor nerves, nor the contractility of the muscles, but when brought in contact with sensory nerves, paralyzes them. Sclerotinic acid depresses the action of the heart in frogs, but not in mammals. In toxic doses it lowers the blood-pressure and reduces the temperature. The respiration is slowed, and, when toxic doses are given, the movements of respiration cease before the heart stops. The peristaltic movements are increased in warm-blooded animals, and the uterus, whether gravid or not, is excited to action. Death is due to paralysis of respiration.

Sclerotinic acid has been freely prescribed by Von Holst, who finds it possessed of a high degree of activity, but other clinicians have been less successful—thus Kobert, of Halle, finds it can not be substituted for ergot. In my own experiments, I have found it produce effects, but not those of ergot proper. Sclerotinic acid is separated by alcohol, but Handelin, who had investigated this subject under the superior direction of Schmiedeberg, finds that ergot loses none of its activity by being extracted with alcohol. Handelin's experiments, made with an aqueous extract, present some points of interest. He found that small doses cause anæsthesia and impair the power of co-ordination, and large doses paralyze reflex and voluntary motions. As the peripheral nerves are unaffected, the paralysis is centric. Small doses lower the blood-pressure temporarily, and large doses permanently. The pulse is at first quickened, and then declines, becoming more and more slow until the heart is arrested.

The first trials with Tanret's crystallized ergotinine were made by Dr. Molé, who found it as effective in uterine hæmorrhage as ergot. The amount that he administered did not exceed four milligrammes in twenty-four hours. Galippe and Budin have also experimented with ergotinine on frogs, cats, and dogs, and produced many of the effects ascribed to ergot, namely, slowing of the pulse, reduction of temperature, paralysis, and convulsions. Peton, another investigator, has also experimented with ergotinine, the results of the action being contraction of the arteries, restlessness, trembling, diarrhœa, etc.

An examination of the results obtained from the experimental and clinical trials with the so-called principles and alkaloids of ergot demonstrates that in no single one are contained all the powers and properties of the drug. It is also evident that ergot, and those principles possessing its powers most nearly, depress the heart, and lower rather than elevate the tension of the arteries. The contraction of the arteries is not, therefore, an active contraction ; and, as the blood accumulates in the veins, there is an anæmia of the cerebro-spinal axis and of the organic muscular fiber. To this condition of things may be referred the phenomena resulting from the exhibition of ergot.

THERAPY.—The only diseases of the intestinal canal to which ergot is applied are *chronic diarrhœa and dysentery*. It is best adapted to those cases in which the chronic succeeds to the acute form, and is not so serviceable in the chronic diarrhœa of warm climates, which has developed slowly, without preliminary acute symptoms. ℞ Ext. ergotæ fluidi, ℥ iijss; tinct. opii deodor., ℥ ss. M. Sig.: *A teaspoonful three times a day.* ℞ Ergotinæ (aq. ex.), ℈j; ext. nucis vomicæ, gr. v; ext. opii, gr. v. M. Ft. pil. no. xx. Sig.: *One every four or six hours.* This last prescription is highly useful in persistent chronic diarrhœa.

Dr. L. G. Andrew has treated *acute dysentery* successfully with the fluid extract of ergot. Dr. W. C. Dabney, of Virginia, urges the local application of fluid extract of ergot in affections of the mucous membrane characterized by enlarged vessels, as, *conjunctivitis, cervicitis, pharyngitis*, etc., and by Dr. Eldridge it has been applied to the treatment of *gonorrhœa, acne rosacea*, etc. The theory of its action in these maladies is the artificial anæmia which it induces in the arterial vessels. Inflammation can not go on, because the blood-supply is inadequate. In the local application the fluid extract of ergot is used. In most cases this may be applied directly to the membrane undiluted. The aqueous extract, or *ergotin*, may be utilized for these purposes also; made into a paste more or less thick according to the character of the surface, it may be plastered on the affected part.

Ergot in the form of the fluid extract, with or without nux-vomica, will often arrest the bleeding of *hæmorrhoids*, and cause such a contraction of the vessels in recent cases as that the symptoms may entirely disappear. This treatment is especially serviceable in the hæmorrhoids which succeed to delivery. *Relaxation of the sphincter ani* and *prolapsus of the rectum* may be ameliorated and, when recent, cured by the same means.

Ergot is a useful remedy in cases of *enlarged heart* (dilated cavities) *without valvular lesion.* It may be given with digitalis: ℞ Ext. ergotæ fluidi, ℥ iijss; tinct. digitalis, ℥ ss. M. Sig.: *A teaspoonful three times a day.* There is now no longer any doubt as to the value of ergot in *aneurisms*, and especially in internal aneurisms beyond the reach of surgical treatment. In these cases the *methodus medendi* is as follows: ergot slows the action of the heart, and causes such a degree of contraction of the arterioles as to produce a great increase of the blood-pressure, whence it follows that the coagulation of the blood in the aneurismal sac is greatly promoted. It is quite conceivable that, as respects small aneurisms of the peripheral main arterial trunks, ergot may effect a cure in the mode suggested by Langenbeck, viz., by direct contraction, under the influence of the ergot, of the unstriped muscular fibers in the affected portion of the vessel. With the use of ergot should be enjoined rest in the recumbent posture, and other measures to favor hyperinosis and the coagulation of the blood in the aneurismal sac.

The recent, more accurate notions, regarding the physiological action of ergot, have led to its employment in various forms of *hemorrhage.* With suitable means for improving the quality of the blood, ergot is very serviceable in the *hæmorrhagic diathesis;* but it is not to be relied on alone. The special indication for its use in hæmorrhage is a want of tonicity of the vessels. It is used in *epistaxis, hæmoptysis, renal, intestinal,* and *uterine hæmorrhage.* Large doses of a suitable preparation are necessary; for, if the drug be inert, nothing but disappointment will be experienced from its use, and small doses do not produce sufficient effect. From half a drachm to a drachm of the powdered ergot, or one to two drachms of the fluid extract, given every half-hour or hour, will be necessary in urgent cases. As powdered ergot rapidly loses its activity by keeping, the fluid extract should be used, and only that prescribed which has been carefully made from the fresh drug. Attention to these precautions will insure more uniform results in *hæmorrhage* than have hitherto been obtained. In *hæmoptysis* the fluid extract of ergot may be given with other appropriate remedies; ℞ Ext. ergotæ fluidi, ℥ iij; ext. ipecac. fluidi, tinct. opii deodor., āā ℥ ss. M. Sig.: *A teaspoonful every half-hour or hour.* When the sputa are heavily charged with blood, and there is no defined hæmorrhage, the following may be used: ℞ Ergotinæ (aq. ex.), ℈j; pulv. ipecac., gr. x; acid. gallic., ℈ j. M. Ft. pil. no. xx. Sig.: *One every hour or two.* In *renal hæmorrhage,* the following is a useful formula and generally very effective: ℞ Ext. ergotæ fluidi, tinct. krameriæ, āā ℥ ij. M. Sig.: *A teaspoonful every hour or two.* Or, ergotine may be prescribed with gallic acid, as in the prescription above given.

The indication for the use of ergot in *menorrhagia* is the existence of the large, spongy uterus—the condition of things which depends on *subinvolution of the womb.* Menorrhagia, when caused by ovarian excitement, is usually more promptly relieved by bromide of potassium, and *metrorrhagia,* produced by fibroids or fungous granulations, is, in the author's experience, much more decidedly held in check by diluted sulphuric acid than by ergot.

When there is reason to believe that *vertigo, epistaxis, headache,* and *tinnitus aurium,* are due to *miliary aneurisms* of the intra-cranial arterioles, most favorable results can be produced by the use of ergot. Also, when there is a sluggish and partially obstructed state of the intra-cranial veins, usually due to chronic arteritis, and accompanied by hebetude of mind, giddiness, epistaxis, etc., these symptoms are made to disappear, and the mental condition is much improved by ergot.

Dr. Crichton Browne, a physician of large experience in these disorders, finds ergot a very useful remedy in certain forms of *mental disease*, for example, "in *recurrent mania*, *chronic mania with lucid intervals*, and in *epileptic mania*." In these mental disorders he assumes the existence of cerebral hyperæmia, and he deduces the curative value of ergot from its power to cause contraction of the vessels.

Migraine, when the attacks are accompanied by suffusion of the face, injected conjunctivæ, and a full pulse—the congestive form—is cured by ergot, and Dr. Kitchen indeed extends its use to almost all kinds of *headache*.

In *epidemic cerebro-spinal meningitis*, ergot is one of the remedies from which the best results are to be expected. In *congestion of the spinal meninges and the cord*, and in *acute myelitis*, this remedy has probably been more uniformly successful than any other, but it must be given in large doses.

Excellent results have been obtained from the use of ergot in *acute inflammation of the conjunctiva*, in *blepharitis*, and in the *phlyctenular ophthalmia* of children.

The long-continued use of ergotin has achieved remarkable results in *chronic metritis*. *Uterine fibroids* and *polypi of the uterus* are greatly benefited in two modes by ergot: uterine action is set up, by which the growth is either compressed or extruded, and the nutrient vessels are so diminished in caliber that atrophy of the morbid growth occurs. The numerous reported instances of success by this treatment, and the author's personal experience of its utility, justify him in urging a trial of this remedy in uterine fibroids and polypi.

In *congestive dysmenorrhœa*, much good may be expected from the use of ergot when the menstrual molimen begins. ℞ Ext. ergotæ fluidi, ʒ vij; tinct. gelsemii, ʒ j; tinct. aconiti rad., gtt. xvj. M. Sig.: *A teaspoonful every two, three, or four hours.* *Amenorrhœa, when dependent on plethora*, has been cured by ergot.

When *incontinence of urine, nocturnal or diurnal*, is caused by a paretic or paralytic state of the *sphincter vesicæ*, relief may be confidently expected from the use of ergot. The fact that one of the ill results of the administration of ergot in large doses is an inability to void the urine, is an interesting explanation of the *methodus medendi* of ergot in these cases.

Ergot is one of the most satisfactory remedies in the treatment of *spermatorrhœa*. It is not useful when the losses are due simply to plethora. Its curative value is especially exhibited in those cases in which the erections are feeble and infrequent, the intromittent power wanting, and the testes relaxed and deficient in secretory activity.

Paralysis of the bladder, the result of over-distention, and occasionally when due to cerebral or spinal lesion, is greatly benefited or cured by ergot.

Ergot was first employed by Da Costa in the treatment of *diabetes insipidus*, and a number of cases have been cured by Murrell, Saunders, and others. The remedy must be perseveringly used, and in full doses, up to the stomach capacity or evidence of physiological action.

Heitzmann has found ergot extremely useful in *acne rosacea*, and other forms of acne. He uses Squibb's fluid extract of ergot mixed with glycerin and water, giving ʒ ss internally, daily.

Ergot in Obstetric Practice.—It is no longer a matter of doubt that ergot promotes uterine contractions ; that it originates them without previous effort of the womb, is questionable. The contractions due to ergot differ from the spontaneous, natural contractions, in being less rhythmical and more tetanic. When large doses of ergot are used, a continuous expulsive effort may be produced. Ergot is indicated in labor when there is *uterine inertia*, the first stage being completed, and no obstacle existing at the outlet. If given before dilatation is completed, the perinæum rigid, and the *ostium vaginæ* not relaxed, disastrous consequences may ensue, both to mother and child. On the part of the mother, the violent and continuous pains—the resistance in front remaining—may cause a rupture of the womb, or the resistance may be overcome by laceration of the perinæum. On the part of the child, it arrests hæmatosis, partly by direct action on the placental blood, and partly by the continuous compression of the body ; but the chief danger is paralysis of the fœtal heart.

It is highly approved by obstetricians at the present time to administer a dose of ergot at the conclusion of the second stage of labor, to insure firm uterine contractions. This practice is held to be the more necessary when previous experience justifies the apprehension of troublesome hæmorrhage. When *post-partum hæmorrhage* occurs, it is universally conceded to be the proper thing to administer a full dose of ergot ; but at the same time other measures must be resorted to in order to procure firm uterine contractions, on which alone depends the safety of the patient. In these conditions the ergot is usually administered in substance—one scruple to a drachm of coarsely-powdered ergot infused in a cup of hot water, the whole being drunk by the patient. From ʒ j to ℥ j of the fluid extract may be given instead—the official preparation representing a grain of ergot to the minim.

The Hypodermatic Injection of Ergotin.—The subcutaneous injection of ergot has become so important a therapeutical resource that it is necessary to treat the subject in a separate division. The solution employed for this purpose is usually as follows : ℞ Ergotinæ (aq. ex.), ʒ j ; glycerini, ʒ j ; aquæ destil., ʒ vij. M. Sig. : *Eight minims contain one grain of ergotin.* Squibb has prepared "an extract of ergot which is almost entirely soluble in cold water, and represents good rye ergot in the proportion of one grain of extract for five grains of ergot. Sixty grains of this extract, dissolved in two hundred and fifty minims of water—the solution filtered, and made up to three hundred minims by passing water through the filter to wash it and the residue upon it—makes a solution which represents ergot in the proportion of minim for grain, and is of the same strength as the fluid extract of ergot, but is free from alcohol or other irritant substance." This preparation the author has found to be admirably adapted for subcutaneous administration. When the aqueous extract of ergot of good quality can not be obtained, the fluid extract may be used.

The rules for the administration of ergot are the same as for other agents applied in this way.

In the treatment of *hæmorrhage*, when a prompt effect is desired, the hypodermatic injection is preferable to the stomach administration. In *hæmoptysis*, the injection may be practiced while suitable remedies are administered by the stomach. In *hæmatemesis*, especially if the stomach be irritable, better results may be obtained by subcutaneous use of ergot than by any form of internal medicine. In *post-partum hæmorrhage*, when to await the action of ergot may endanger the life of the mother, the subcutaneous administration should be resorted to. The happy results which have attended this mode of administration in serious cases, demand that the *accoucheur* be provided with the necessary appliances for the hypodermatic injection of ergot in every obstetrical case. This mode of using ergot is not only prompter in results, but is more effective in securing uterine contractions and arrest of hæmorrhage.

The good results which are obtained from the stomach administration of ergot in *subinvolution of the uterus* and in *chronic metritis*, are much more quickly and decisively obtained from the subcutaneous administration. Since the memoir of Hildebrandt appeared, numerous cases of successful treatment of *uterine fibroids* by hypodermatic injection of ergotin have been published. There seems to be no longer any doubt that this agent administered in this way, and less effectively and for a much longer period by the stomach also, has the power to arrest the growth of uterine fibroids, to cause them to atrophy, or to set up such a degree of uterine action as to compel their extrusion as polypi from the uterine cavity. It has, of course, long been known that ergot administered by the stomach may induce such a degree of uterine contraction as to expel a polypus. In those instances in which the hypodermatic injection fails to arrest the growth of a polypus, notable improvement in the amount of the hæmorrhage and of the muco-purulent discharge is, at least, a result of the treatment. The author is enabled to speak from personal observation of the excellent results obtained by this mode of treatment in many cases.

From two to six grains of the aqueous extract of ergot (ergotin) may be injected under the skin in these cases of uterine fibroids on alternate days, or thrice or twice each week. The abdomen is usually preferred as the site of the injection. More or less pain is experienced at the moment of the insertion of the solution, and an indurated spot, which may be more or less sore, will remain for a week or more. Suppuration may result from the injection, but it is not a frequent accident.

The hypodermatic injection is an effective mode of treating *varicocele.* About two grains of the extract in solution is a suitable dose. The needle is inserted so that its point will rest among the dilated veins, but care must be taken not to puncture a vein. Very severe pain follows, and there may be great faintness, but the effects subside in a few hours unless considerable swelling should ensue, which is quite usual. A single injection may cure a very extensive varicocele, and more than two are rarely necessary. *Varicose veins* in other parts, especially of the inferior extremities, have been cured by the same treatment. The following is the mode of proceeding in these cases: the needle is inserted under the skin, in close juxtaposition to the enlarged vein, and the fluid is so injected as to lie alongside of the vein, but not to enter it. The cure which follows in many of these cases has been ascribed to the inflammatory swelling which takes place, but there is, doubtless, besides this effect, a dynamical influence exerted on the vessel-walls.

It has lately been asserted that *deficient erections* and *loss of the capacity for coitus* are not unfrequently due to enlargement of the dorsal vein of the penis, and consequent too rapid emptying of the veins of the erectile tissue. Acting upon this plausible suggestion, the author has practiced the hypodermatic injection of ergotin about the dorsal vein of the penis, and he has had apparently excellent results.

Before closing this article, it may be advisable to recall to the reader's attention the fact that the hypodermatic injection of ergot, or its internal administration in large doses, may cause such tonic contraction of the *sphincter vesicæ* as to render micturition impossible. Careful inquiry and frequent examinations of the hypogastric region should be made during a course of ergot preparations.

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Ustilago.—Ustilago. *Ustilago maydis* Levéillé (Nat. Ord. *Fungi*) grows upon *Zea mays* Linné (Nat. Ord. *Graminaceæ*).

Extractum Ustilaginis Maydis Fluidum.—Fluid extract of ustilago. Dose, ♏x — ʒj.

COMPOSITION.—An active principle—*ustilagine*—has been lately found, and some of the ingredients existing in ergot have been detected, as *secaline* so called, and *trimethylamine;* but the latter is regarded by others as a decomposition product and not existing preformed. Besides other substances, Parsons has separated an acid, which he regards as similar to the *sclerotic acid* of Dragendorff, and a substance soluble in ether but not in alcohol.

PHYSIOLOGICAL ACTIONS.—Several important investigations of the actions of ustilago have been made in the laboratory of experimental therapeutics of Jefferson Medical College, which agree for the most part with the account to follow, and which we owe to Dr. Hoffman, whose work was done in the college laboratory three years ago.

The researches above referred to will appear in a special volume, now preparing.

Both in cold- and warm-blooded animals, ustilago acts as a spinal excitant, causing convulsions of a tonic character. It also heightens sensibility and the reflex function, so that the least irritation of the skin induces general tonic convulsions of the tetanic or strychnic character. Frequent irritation and repeated convulsions rapidly exhaust the animal. On the other hand, quiet, darkness, and relief from all irritation, diminish the severity of the convulsions, and prolong life, if not prevent a fatal result. Death may ensue in a convulsion by tetanus of the respiratory muscles. Muscular tremors, general, occur in warm-blooded animals, and muscular weakness (paresis) appears in the intervals between the convulsions. The irritability of the motor nerves, and, toward the end, of the sensory nerves also, declines, but is not entirely lost, and the contractility of the muscles lessens semewhat. That the convulsions are spinal, is a fact proved by destroying the cord in a frog before administering the medicament, when no muscular action of any kind takes place. Section of the medulla or decapitation does not prevent the occurrence of the convulsions.

Ustilago slows the heart, and by numerous control experiments this action was shown to be due to stimulation of the pneumogastric and its terminal ganglia. It dilates the pupil, and affects the acuteness of vision for near objects.

We have no exact data in regard to the action of this agent on the uterine system. An impregnated cat, dying by a merely lethal dose slowly, did not abort; but it is said that pregnant cows and bitches, after eating ustilago, have dropped their young.

The modes of dying are two: in the tetanus; by exhaustion. In the former, the respiration is arrested, violent tonic extension of the voluntary muscles takes place, the head being drawn back, the toes incurved. In the latter there is gradually increasing paresis between the convulsions, and slowing of the heart's action. The difference is largely due to the dose and rapidity of administration. A lethal dose for a rabbit weighing 25 ounces seems to be one drachm of the fluid extract.

Digitalis.—The leaves of *Digitalis purpurea* Linné (Nat. Ord. *Scrophulariaceæ*), from plants of the second year's growth. (U. S. P.) *Feuilles de digitale*, Fr.; *Fingerhutblätter*, Ger.

Infusum Digitalis.—Consists of digitalis, bruised, 15 grm.; alcohol, 100 c. c.; cinnamon-water, 150 c. c.; boiling water, 150 c. c.; and cold water sufficient to make 1,000 c. c.

The boiling water is poured over the digitalis in a suitable vessel and allowed to macerate until cold; it is then strained and the alcohol and cinnamon-water are added, and enough cold water is passed over the residue on the strainer to measure 1,000 c. c. Dose, ʒ ij—℥ ss.

Extractum Digitalis Fluidum.—Fluid extract of digitalis. Dose, ♏j—♏iij.

Extractum Digitalis.—Extract of digitalis. Dose, gr. ss—gr. ij.

Tinctura Digitalis.—Tincture of digitalis. Dose, ♏v—ʒ j.

Composition.—Digitalis contains an active principle, *digitaline.* This exists in the amorphous and crystalline form. The amorphous form—the digitaline of Homolle and Quévenne—possesses considerable activity, and, according to some authorities, is quite equal to the crystalline in strength. The crystalline digitaline (Nativelle's digitaline) occurs in needle-shaped crystals and has an extremely bitter taste.

According to Schmiedeberg, digitalis contains *digitonine*, which strongly resembles saponine ; *digitaline*, which is insoluble in water, and is the chief constituent of Homolle and Quévenne's digitaline ; *digitaleïn*, which is readily soluble and has the same action as German digitaline ; *digitoxine*, the most powerful, and is the principal constituent in Nativelle's digitaline. Koppe has examined the action of digitaline, digitaleïn, and digitoxine, and finds that they agree in their action, and with the crude drug, but differ in degree of activity.

Digitalinum.—Digitaline. A white, or yellowish-white powder, without odor, and having a very bitter taste. Dose, $\frac{1}{60}$—$\frac{1}{30}$ of a grain.

Antagonists and Incompatibles.—The cinchona preparations, acetate of lead, the sulphate and tincture of the chloride of iron, are chemically incompatible. Tannic acid and the preparations containing it diminish the physiological activity of digitalis. Opium, aconite, lobelia, and the cardiac paralyzers, antagonize some of the actions of digitalis, but the antagonism does not extend throughout the whole range of their influence. The most complete physiological antagonism exists between digitalis and saponine (Köhler), the active principle of *Saponaria officinalis*, closely allied to *senegine*. Aconite antagonizes the cardiac action of digitalis, and morphine, also, to a less degree.

Synergists.—Cold, ergot, belladonna, increase the physiological activity of digitalis.

Physiological Action.—Digitalis has a disagreeable, bitter taste. In considerable doses, of the infusion, for example, it disturbs the stomach and gives rise to nausea and vomiting, and frequently purges. Loss of appetite results from its medicinal administration in some subjects, even when the quantity is small ; but, in others, the appetite is increased. The active constituents of digitalis diffuse into the blood, but nothing is definitely known as to the action of this agent on the composition of the blood, or the influence which it has, if any, on the morphological elements.

On the heart digitalis exerts a peculiar action which requires attentive examination : it prolongs the *diastole* and increases the vigor of the *systole*. A lethal dose arrests the heart in systole, inducing a tetanic state of the heart-muscle. While digitalis increases the power of the systole, the diastole is prolonged, hence the number of pulsations per minute is reduced. With ordinary medicinal doses this slowing of the heart may be considerable, and the pulsations may descend to fifty or even forty per minute. Microscopic examination of the mesentery (Ackermann) and of the web of the frog has definitely ascertained that a marked contraction of the arterioles takes place under the influence of digitalis. The increased power of the systolic contraction of the heart and the greatly-increased resistance in front from a narrowing of the caliber of the vessels produce, as might *a priori* be expected, a considerable rise of the blood-pressure. When the pulse is greatly reduced by the administration of large medicinal doses, a change from the recumbent to the upright posture causes a remarkable increase in the number, and diminution in the force, of the cardiac pulsations. When lethal doses, short of a sudden toxic effect, have been experimentally administered, the slowing of the heart and rise of arterial tension first produced are succeeded by a quick, feeble pulse, and fall in the blood-pressure. These results are obviously due to the loss of power (paresis) which results from over-stimulation.

A temporary rise of temperature follows the administration of a lethal dose of digitalis, but this rise is soon succeeded by a marked and sustained reduction. Owing to the increased resistance from diminution of the caliber of the arterioles, the actual energy expended by the heart is in part converted into heat. Subsequently the slowing of the circulation, especially through the lungs (Traube), hinders the combustion process, and hence the fall of temperature.

Digitalis in full medicinal doses produces headache, a band-like feeling around the forehead, dizziness, disturbances of vision (mistiness, vibratory movements of external objects, chromatic dispersion, etc.), drowsiness, languor, and a sense of weariness, and it may even cause hallucinations, illusion, and delirium. Digitalis lessens the reflex function of the cord, lowers the sensibility of the nerves, motor and sensory, and impairs the electro-contractility of muscles ; but these effects are not produced by medicinal doses, but are toxic in character.

As might be anticipated from a study of its physiological actions, digitalis acts like ergot on the enlarged uterus ; it stimulates to energetic contraction the muscular fibers, and in this way arrests uterine hæmorrhage. On the genital organs of man it has a similar action ; by diminishing the blood-supply to the erectile tissue it lessens the power of erections, and, secondarily, affects the venereal appetite, producing anaphrodisia.

Considerable difference of opinion exists as to the influence of digitalis on the function of nutrition—the metamorphosis of tissue. By some an increase in the production of urea, by others a diminution, has been noted. The truth, most probably, is that it has no real influence on urea formation, and that the variations observed are accidental. The phosphoric acid and chlorides are diminished. In health digitalis affects but little the water of the urinary secretion ; according to some the water is diminished, according to others increased. It is difficult to reconcile these opposing statements, in view of the fact which has recently been ascertained by Brunton, that the diuretic action of digitalis in dropsy is not due to the increased blood-pressure, but to a special action on the Malpighian tufts.

Therapy.—To obtain the best results from the administration of digitalis, it must be of good quality and the preparations made with great care. Every precaution taken, it is still difficult to manage, because so apt to disorder the stomach and derange digestion. Recent experience has appeared to show that the most powerful and effective, yet manageable, of the constituents is digitoxine. This is a white crystalline substance, insoluble in water, of which the dose is $\frac{1}{125}$ grain to $\frac{1}{150}$ grain, and is best administered in pill or wafer. It may be advantageously combined with adonidin and sparteine in various cardiac affections and dropsy.

Digitalis has an undoubted power to arrest *hæmorrhage* (Leyden). The mechanism of its action is similar to that of ergot; it slows the action of the heart and contracts the arterioles. In *hæmoptysis* it is especially useful in the following state of things: frequent expectorations of bloody mucus, with occasionally a mouthful of florid blood, accompanied by fever. This group of symptoms is dependent on transudation from a number of small vessels about the site of a pneumonia due to a tubercular or caseous deposition. The same kind of expectoration, due to *pulmonary congestion from mitral regurgitation*, is amenable to the same treatment. In *uterine hæmorrhage* digitalis is also serviceable, but it is more especially indicated in *menorrhagia* and *metrorrhagia* of plethoric subjects. Like ergot, digitalis has the power to induce uterine contractions, and hence it has been used successfully to arrest *post-partum hæmorrhage.* Cases of *menorrhagia*, of a peculiarly obstinate kind, are caused by mitral regurgitation or stenosis, the mechanical result being to increase the blood-pressure in the venous system of the uterus. Digitalis is the appropriate remedy in such cases. Granules of digitaline may be prescribed for some days previously to the occurrence of the menstrual molimen, but during the attack the infusion of digitalis is more serviceable. In cases of hæmorrhage, generally speaking, the infusion is the most effective form in which to employ digitalis. If the symptoms are urgent, a tablespoonful of the infusion may be given every half-hour until four doses are taken. In ordinary cases a tablespoonful of the infusion twice a day is a sufficient quantity to maintain a constant physiological effect. In the treatment of hæmorrhage, digitalis may be combined with other remedies which are synergistic. ℞ Infus. digitalis, ℥ ij; tinct. krameriæ, ext. ergotæ fluidi, āā ℥ j. M. Sig.: *A tablespoonful pro re nata.*

In *purpura* and *the hæmorrhagic diathesis*, digitalis is useful when given conjointly with restorative medicines; but, as a dyscrasia exists on which the extravasations of blood depend, it is obviously necessary to correct this state of things, in order that the patient shall be benefited by a remedy which gives tone to the heart and vascular system.

The most important uses of digitalis are in *cardiac diseases.* In general terms it may be said that *it is indicated when the action of the* *heart is rapid and weak and the arterial tension low, and is contraindicated when the action of the heart is vigorous and the arterial tension high.*

In *simple hypertrophy*, which is compensatory, digitalis has no utility. In *stenosis of the aortic orifice, with compensatory hypertrophy*, it is not only useless, but it may give rise to serious symptoms, and even cause a fatal result, if administered in doses sufficient to produce physiological effects (Fernet). When stenosis of the aortic orifice leads to incompetence and regurgitation of the mitral, then digitalis may be used with advantage. As respects the nature of the cardiac lesion merely, digitalis is useful in dilated heart with incompetence of the mitral, in disease of the mitral orifice with stenosis or regurgitation, and in dilatation of the right heart with incompetence of the tricuspid. As respects the mechanical difficulties which ensue from cardiac lesions merely, digitalis is useful, by reason of the increased power which it gives the auricles and ventricles to empty their respective cavities, and the longer intervals between the pulsations, which enable the auricles more perfectly to discharge their contents into the ventricles. The mechanical difficulty consists in a deficiency of blood (*ischæmia*) on the arterial side, and a stasis of blood on the venous side, of the systemic and pulmonary circulation. Digitalis, therefore, assists in the "compensation," or, in other words, by its action on the heart restores the mechanical balance of the circulation, deranged by the cardic lesions. As respects the rational symptoms of heart-disease, digitalis is useful when the action of the heart is rapid and weak, the tension of the pulse low, when there are cough, difficulty of breathing, a dusky countenance, pulsating jugulars, scanty and high-colored urine, and general dropsy. As a rule, it may be stated that the rational signs furnish more conclusive indications of the need of digitalis than the physical. If given in suitable cases, the action of digitalis in heart-diseases is most conspicuous for good; but careful consideration should be given to the conditions detailed above if the practitioner would procure thoroughly satisfactory results. The form in which digitalis is prescribed is most important. The infusion is the best form in cases of cardiac disease with dropsy. It should be given in tablespoonful doses, twice a day, until some characteristic physiological effects are produced. After the subsidence of the severe symptoms, digitaline-granules may be substituted for the infusion, or the powder of the leaves may be given in pill-form. As very decided anæmia is present in these cases, the best results are obtained by a combination of digitalis with quinine and iron. ℞ Pulv. digitalis, ℈ij; ferri redacti, quininæ sulph., āā ℈j. M. Ft. pil. no. xx. Sig.: *One pill two or three times a day.*

The *antipyretic effect* of digitalis is a fact much insisted on in Germany (Traube, Wunderlich, Thomas, Liebermeister, etc.). In the recent elaborate work of Husemann digitalis is classed with the *Fiebermittel*—the "antipyretica." The results which have followed its administration as an antipyretic in fevers (typhoid, typhus, etc.) do not, it appears to the author, justify its use in these maladies, notwithstanding its power to lower the temperature. Prof. Leyden regards it as unsafe as an antipyretic. The indications for its use are, according to Liebermeister, just the opposite of those which obtain in cardiac disease; that is, "digitalis is only to be used in those cases of typhoid fever in which there is no considerable degree of cardiac weakness." He usually gives from eleven to twenty-two grains, extended over a period of about thirty-six hours.

In *scarlet fever* the utility of digitalis is very great; it lowers the temperature and maintains the action of the kidneys, thus obviating the two principal sources of danger in that disease. Dr. Daniel Lewis, of New York, influenced by the author's opinions on this point, systematically used digitalis as the chief remedy in an epidemic of scarlet fever in New York, and presented the results in a paper submitted to the State Medical Society. While the mortality from this disease, for the city at large, is 23 per cent, for Dr. Lewis's cases it was less than 11 per cent. From a teaspoonful to a tablespoonful (according to age) of the infusion every two, three, or four hours, is a suitable mode of administration. If uræmia occur, the infusion is the proper remedy, conjoined, of course, with other means. The author has seen most excellent results from a poultice of digitalis-leaves, applied to the abdomen and back, in cases of *uræmic convulsions*, the patient being unable to swallow, or the stomach so irritable as to reject all medicines.

Digitalis has been used with success in *erysipelas*, but it is by no means equal to belladonna in this affection.

In *rheumatic fever* the testimony in favor of the use of digitalis is certainly very strong. It lowers the temperature, and apparently materially shortens the duration of the disease. It may be given in powders—two grains every four hours—or a corresponding quantity of the infusion. In rheumatism, as in every other affection, very prompt effects do not follow the use of digitalis; a day or two must elapse before any marked reduction of temperature takes place, but a cessation of the joint-trouble may be looked for in seven to ten days. Digitalis is more particularly useful in the *cardiac compliations of acute rheumatism*, when irregular and feeble action of the heart, difficult breathing, cyanosis, and general œdema, are present. The following is a prescription of Oppolzer in this condition: ℞ Inf. digitalis, ℥ ij; liq. potassii citrat., ℥ jss; acet. scillæ, ℥ ss. M. Sig.: *A tablespoonful every four hours.*

Digitalis has recently been much employed in *inflammatory affections*, notably *pneumonia*. On examination of the reported cases the author finds that the defervescence, produced apparently by digitalis from the sixth to the tenth day, occurred at the time when the *crisis* in pneumonia is to be expected, and hence it is difficult, if not impossible, to estimate the precise share which the remedy had in the results. That digitalis has any power to prevent the deposition of fibrinous material, to prevent or check the migration of the white corpuscles, or to arrest the multiplication of the cellular elements of inflamed parts, seems to the author highly improbable. That it may be useful to combat some of the symptoms—high temperature, ischæmia of the arterial system from pulmonary obstruction, and low tension of the vessels—may be well admitted.

There is considerable evidence to show that digitalis is serviceable in *chronic bronchitis with interstitial pneumonia* (fibroid lung), when accompanied with difficult breathing, secondary dilatation of the right cavities, and *general anasarca*. It diminishes the cough and expectoration, tones up the weakened and laboring heart, and reduces the œdema. That digitalis has any curative power in *pulmonary tuberculosis* or *caseous pneumonia*, can hardly be credited, notwithstanding the claims which have been put forward. It may be used as an *antipyretic* when there is much hectic, but the derangement of the intestinal canal produced by it is a most serious bar to its employment in phthisis.

Some important results have been obtained by the use of digitalis in *nervous diseases*. The *congestive form of hemicrania* may not unfrequently be permanently relieved by the persisten' use of digitaline-granules (one sixtieth of a grain *bis die*). *Acute maniacal delirium*, *chronic mania*, and *delirium tremens*, are disorders of the brain in which digitalis has proved very useful. The conclusions of Dr. Williams, of Hayward's Heath Asylum, are as follow:

"1. That digitalis is a valuable sedative in the treatment alike of recent and chronic mania, and when these forms of disease are complicated with general paresis and with epilepsy.

"2. That the average dose of the tincture is from ʒ ss to ʒ j, and this quantity may be certainly given with impunity for several days, and subsequently—adjusted to the state of the pulse—may be advantageously used for several months.

"3. That the indication by which the use of this drug is regulated is the state of the pulse, any marked intermittence requiring its immediate discontinuance.

"4. That the weakness of the circulation is no indication against its employment; on the contrary, experience shows that the most enfeebled subjects bear its administration as well as the most robust."

In *delirium tremens* extraordinary doses of the tincture of digitalis have been used with success (ʒ ij—ʒ iv), but these large doses are unnecessary. This treatment is most useful in the young and robust, with marked cerebral hyperæmia, according to some; but, according to others, in pale subjects with a tendency to cyanosis, the state of the brain being one of anæmia, with effusion and œdema. According to the author's observation, the latter indications are the more correct. The infusion is doubtless a better preparation than the tincture, and of this a tablespoonful may be administered every four hours.

Some supposed cases of *arachnitis* have been reported cured by digitalis, but grave doubts must exist as to the accuracy of the diagnosis.

Cases of *exophthalmic goitre* in young subjects, purely functional in character, have been cured by *digitalis*, and the cardiac irregularities, and the dilatation of the cervical vessels, ameliorated in even incurable cases. Digitaline is the form in which to employ this remedy, or powdered digitalis may be given in pill, with iron and manganese to remove the anæmia.

Since the anaphrodisiac properties of digitalis were ascertained, it has been much used in *spermatorrhœa.* It is adapted to the same class of cases as those in which ergot has been shown to be so beneficial, viz., feeble erections, frequent emissions, and cold hands and feet. The author has seen better results from the combination of bromide of potassium and digitalis, in the spermatorrhœa of plethora, than from any other remedies: ℞ Inf. digitalis, ℥ viij; potassii bromidi, ℥ j. M. Sig.: *A tablespoonful morning and night, and, after a week, at night only.*

Digitalis is one of the most generally useful remedies in dropsy which we possess. It is, of course, specially indicated in the mechanical dropsy of valvular lesions. In *renal dropsy* from *acute desquamative nephritis* (tubal nephritis) "of all drugs, digitalis is of the greatest value," and the best form in which to administer it is the infusion. Several days usually elapse before very decisive results are achieved, but the flow of urine is, then, often enormous. The fact that, contrary to what has been heretofore believed, digitalis has a direct action on the glomerule of the kidney, is of great interest in this connection. The author has seen very favorable results from the use of digitalis in *granular degeneration of the kidney* when dropsy supervened, but its use in this disease requires caution in consequence of the fact that the elimination of urea and of the chlorides is retarded by this agent.

The so-called Cumulative Effects of Digitalis.—The author agrees in opinion with those who hold that digitalis is not a cumulative poison in the sense in which this term was formerly used. Doses of digitalis frequently repeated, so that the effect of one is added to those before given, will certainly produce toxic symptoms. In this sense opium, belladonna, strychnine, etc., are cumulative poisons. If full doses of digitalis are given at proper intervals, and the effects of one dose are permitted to cease before the next is given, no accumulation will take place. Sudden toxic symptoms are developed as follows: When, after the administration of large doses, the pulse is much reduced in the recumbent posture, on rising, the heart is suddenly found unequal to maintaining the circulation in face of the increased resistance in the arterioles and against the force of gravity. It must not be forgotten, further, that the irritability of the vaso-motor nervous system may be destroyed by over-stimulation by digitalis, and lethal effects be produced in this way.

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Convallaria.—The rhizoma and roots of *Convallaria majalis* (Nat. Ord. *Liliaceæ*).

THE PREPARATIONS.—It is a remarkable fact that different properties are possessed by extracts made from the various parts of the plant. An extract made from the root has very powerful emeto-cathartic property, while it but little affects the action of the heart. The same fact is true, to a less or greater extent, of extracts from the whole plant. This emeto-cathartic action is due to the presence of a rather acrid resin, and hence for the purpose now intended to be subserved by the administration of convallaria the preparation used must be freed from this resin. An extract prepared from the flowers and stalks, mixed with a third of their weight of leaves and root, is, according to Langlebert, the best preparation, when deprived of the resin. In this shape it is a solid extract, has a shining black color and a bitter taste, and is freely soluble in water and alcohol.

Extractum Convallariæ Fluidum.—Fluid extract of convallaria. Dose, ♏v—ʒ ss.

An infusion of the flowers, leaves, and stems is also used. Troitzky employed several formulas in his trials—from two to four scruples of convallaria to four ounces of water.

Infusum Convallariæ.—Infusion of convallaria (convallaria, 50 parts; water, 200 parts). Dose, a tablespoonful. Another formula is eight ounces of convallaria to a pint of boiling water, which is twice the strength of the above.

As the active principle presents many advantages, this will probably be preferred for administration in cardiac affections.

Composition.—In 1858 Walz announced the presence in this plant of two glucosides—*convallarin* and *convallamarin*. There are important differences in the qualities of these substances. The former, convallarin, occurs in colorless, rectangular prisms, is slightly soluble in water, but freely so in alcohol. Convallarin, as Marmé first ascertained, is a purgative in doses of three or four grains (Husemann). It is probable that the presence of this glucoside in the resin is the secret of the cathartic property of this substance, in part at least. Convallamarin is not crystallizable, is a white powder, bitter, and freely soluble in water and alcohol, but not in ether. The dose when administered by the stomach will range from one fourth of a grain to two grains; but further investigations are needed to decide this point. This is the principle of convallaria, to which its cardiac actions are due. It is probable that the perfectly pure alkaloid possesses much greater activity than the dose above stated indicates.

Physiological Actions.—For some time no other powers were attributed to convallaria than those of a cathartic intermediate in action between scammony and aloes. In Russia it has long been known as a remedy for dropsy. This fact finally induced Troitzky and Bojojawlensky to study its action more closely, and Prof. Botkin, of St. Petersburg, subsequently confirmed their researches.

It was not, however, until Prof. Sée undertook the study of its powers and actions, that general interest was aroused, although Marmé had, as is stated above, some time before, given an accurate account of the physiological actions of convallaria. Since the publication of Sée's observations, the actions of this medicament have been investigated by various English and American observers. From these sources, and some personal studies, the author makes up the following account:

Notwithstanding the emeto-cathartic action, if the extract freed from the resin, or convallamarin, the active principle, is given, no disturbance of the stomach occurs. It stimulates the appetite somewhat, and digestion is not impaired. An increase of peristalsis occurs, and the evacuations, without being loose, become easy. In warm-blooded animals it slows the heart and raises the arterial tension. At the same time the respiratory movements are rendered more full and somewhat less frequent. These effects are due to stimulation of the vagus, but the nerve does not lose its irritability. If the dose be lethal, after this first stage, the heart becomes irregular in rhythm, the force of the cardiac contractions varies, and the respirations are disturbed, inspiration growing deep and prolonged, owing to spasm of the inspiratory group of muscles (Sée). In the third period of the action, just before death, the arterial tension rises very high, but the pulse is exceedingly rapid ; then the pressure falls, the respiration growing deeper and very slow, and the heart stops in systole, before the breathing finally ceases. The vagus does not wholly lose its irritability, but near the end a strong faradic current does not stop the heart. The irritability of the motor and sensory nerves remains unaffected, and the muscles preserve their contractility. The pupil is unaffected and the functions of the brain are undisturbed.

The diuretic effect of convallaria is very constant and decided, a fact long known in Russia, but no change occurs in the composition of the urine.

THERAPY.—In suitable doses—15 to 25 grains of the extract—convallaria slows the heart-beats, and often restores the normal rhythm of the heart when disturbed, increases the energy of the cardiac contractions, raises the arterial tension, and at the same time the respiratory movements acquire increased force and volume. These important therapeutical effects are wrought without affecting the functions of the brain and spinal cord. It is also a prompt and certain diuretic, increasing the discharge of all the urinary constituents. The therapeutical indications based on these physiological actions are the following : Palpitation, disordered rhythm, or vehement action, dependent on impaired function of the pneumogastric, or on hypertrophy of the muscular walls ; narrowing of the mitral orifice (mitral stenosis) or insufficiency of the mitral valves, with stasis in the venous circulation, with or without spasmodic breathing ; dilated heart, with or without fatty change or sclerosis ; in all cardiac affections accompanied by dropsy (Sée). The signal advantage which it offers over digitalis is the absence of danger from its administration, and the freedom of the cerebro-spinal axis and the digestive organs from disturbance. It has now been used in the maladies above mentioned by numerous observers in various parts of the world ; and, although the reports are not uniformly favorable, there can be no doubt that we have in convallaria an important addition to our resources.

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Strophanthus.—(The Kombé arrow-poison.) The seeds of *Strophanthus hispidus* De Candolle (Nat. Ord. *Apocynaceæ*).

COMPOSITION AND PROPERTIES.—The active constituent of strophanthus is a glucoside, to which the name *strophanthin* has been given. It is contained in largest proportion in the seeds—from eight to ten per cent. The dose is $\frac{1}{100}$ to $\frac{1}{60}$ grain.

Strophanthin is crystallizable, slightly acid in reaction, freely soluble in water and in alcohol, but insoluble in ether, chloroform, and benzine.

Tinctura Strophanthi.—Tincture of strophanthus. Strophanthus in No. 30 powder, 50 grm. ; alcohol and water, of each a sufficient quantity to make up to 1,000 c. c. Dose : the initial quantity may range from one minim to ten minims, according to the manner of giving it. To maintain a uniform action, the initial dose may be larger, and the impression continued by small doses at short intervals.

An extract may be prepared by evaporation of the tincture, after the method of Rice. By a committee of the United States Pharmacopœia Revision, experiments were made with the extract and tincture, and also with strophanthin, confirmatory of the observations of Rothziegel and Koralzewski, who had previously found that the glucoside was most active ; but the physiological actions are the same.

Strophanthin can be administered subcutaneously by means of a solution of one grain to the ounce of chloroform water. Five minims contain about $\frac{1}{100}$ grain. Such a solution will remain sterile for at least several days.

ACTIONS AND USES.—Strophanthus is bitter in taste, and, like many other bitters, promotes appetite and digestion. It is not irritating to the stomach, and apparently does not cause nausea. The property for which it is now introduced, however, is the more important one—that of cardiac tonic. Strophanthus slows the heart-beat, lengthens the interval between the contractions, and increases the energy of the cardiac muscular tissue. The arterioles are, to some extent, acted upon, and contract; but the rise of the blood-pressure is due more especially to the increased power of the cardiac contractions. The action of the heart is arrested in the diastole.

In consequence of the slower movement of the heart and the lessened caliber of the peripheral vessels, the quantity of blood distributed in a given time is relatively diminished; hence the consumption of oxygen is smaller, and the activity of the combustion-process correspondingly depressed. Strophantus is therefore an antipyretic within a quite limited range. Some diuretic power is also attributed to it.

On the foregoing physiological data the therapeutical properties are based. It has been prescribed with very distinct good effect in cases of mitral disease not compensated. Like digitalis, it lessens the ischæmia of the arteries, and increases the rate of movement of the blood in the veins; but, unlike digitalis, it does not much affect the caliber of the arterioles, and consequently does not so much increase the work of the heart by contracting them. If these valuable observations, which we owe to Prof. Fraser, be entirely confirmed by future investigations, strophantus will largely supersede digitalis in mitral lesions with its attendant disturbances.

Strophantus does not have a cumulative action, it is said; but that must depend on the frequency of administration, for if the doses are given at such a rate that the effects of one have not ceased before another is administered, clearly some accumulation of power must take place.

Sparteine.—As a member of that group of which digitalis has so long been the chief, it well deserves attentive consideration.

Sparteinæ Sulphas.—Sulphate of sparteine. A neutral sulphate of an alkaloid obtained from *Scoparius*. Occurs in colorless, white, prismatic crystals, or a granular powder, odorless and having a slightly saline and somewhat bitter taste. Very soluble in water and in alcohol.

HISTORY AND PROPERTIES.—Sparteine was discovered so long ago as 1856 by Stenhouse, but it was not until 1883 that it was taken up for examination. It is a liquid alkaloid, contains no oxygen, its formula being $C_{30}H_{26}N_{21}$, and it has strong basic qualities, combining readily with acids to form salts. The sulphate, which is crystallizable, dissolves freely in water, while the alkaloid itself is entirely insoluble.

The dose of the sulphate of sparteine is from gr. ss. to gr. ij. This salt crystallizes in rhomboidal plates, and, as it is so readily soluble in water, it can be administered subcutaneously or by the stomach, as circumstances may require.

ACTIONS, PHYSIOLOGICAL AND THERAPEUTICAL.—The physiological actions of sparteine were first studied by Mills in 1863, and by Fick in 1870, afterward by Rymon in Vulpian's laboratory, by Laborde and Legris, by Gluzinski and others, and its therapeutical applications have been illustrated by Voigt in Nothnagel's clinic, and by Prof. Sée. From these various sources, and from his personal investigations, the author has formulated his conceptions of the real place which sparteine should occupy as a remedy.

The salts of sparteine are bitter, but not irritating to the stomach, and apparently have the tonic action, the power to improve appetite and digestion, common to the bitters. Unlike digitalis, sparteine acts within an hour or two (Laborde, Voigt) after it is taken, the characteristic impression on the heart being made. It more truly deserves the title of "heart-tonic" than any other remedy. Irregularity in rhythm, inequality in the force of the contractions, are almost immediately corrected, and the action is lasting as well as thorough. It is especially in derangement of the motor apparatus of the heart, with weakness and irregularity of the pulse, that sparteine affords relief in an hour or two, when digitalis would require a day or two to accomplish the same result. So small a dose as one half a grain, as a rule, brings about the result above described, and the effect persists twelve to twenty-four hours, although a single dose had been given. The special conditions in which it is most useful are weakness of the right heart and incompetence of its valves, and in lesions and functional derangement of the mitral (see Voigt and others). That the curative results obtained by the use of sparteine are not hampered by gastric disorder is another proof of its superiority to digitalis.

If digitalis is to be administered in cases of mitral disease and prompt action is necessary, sparteine performs a valuable function, for if at once given the heart is relieved, and the relief continues until digitalis has had time to act. Laborde and Legris, Rymon, Gluzinski, and others from the experimental standpoint, and Vulpian, Huchard, Voigt, and others from the clinical, conclude that sparteine is the first of the remedies now available as a "heart-tonic," and as a regulator of the cardiac rhythm when disordered in function merely, and when due to lesions of the heart-muscle or valves.

Sparteine has no "cumulative action" in the sense in which that phrase is applied to digitalis. In summing up their observations Laborde and Legris assert that in all cases of weak heart with asthenia, whether or not organic lesions exist, sparteine is the appropriate remedy, and they do not know of any proper contra-indications, as it agrees well with the stomach, and has no injurious effect on the cerebro-spinal nerves.

Adonidin.—The active principle—a glucoside—of *Adonis vernalis*, a member of the *Ranunculaceæ*.

Properties.—Adonidin is an amorphous substance, without odor, colorless, and intensely bitter. It is soluble to a very trivial extent in water, but is freely soluble in alcohol. The dose of adonidin is one eighth to one half grain, and the best form for administration is the compressed pellet or granule.

The first study of adonidin was made by Bubnow in Prof. Botkin's laboratory; but he failed to isolate the active principle, which was subsequently accomplished by Cervello, of Strasburg.

Actions and Uses.—Although there are differences of opinion on this point, it is probable that adonidin, in many subjects, causes nausea, vomiting, and diarrhœa (Leyden). The chief function for which it has been used in medicine is as a substitute for digitalis. It slows the heart, lengthens the interval between the beats, and raises the general vascular tension by contracting the arterioles. It has also considerable diuretic power, increasing the flow of water and of solids (Lublinski).

Adonidin acts more quickly and also more powerfully than digitalis, and, in some instances, it has seemed to have more curative power. To begin the action before digitalis has had time to act, to supply its place in cases of idiosyncrasy, and to form combinations when the action of each is supplemented, are the various conditions which justify the use of adonidin.

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Cimicifuga.—Black snake-root. The rhizoma and rootlets of *Cimicifuga racemosa* Elliott (Nat. Ord. *Ranunculaceæ*).

Extractum Cimicifugæ Fluidum.—Fluid extract of cimicifuga. Dose, ʒ ss — ʒ ij.

Tinctura Cimicifugæ.—Tincture of cimicifuga. Dose, ʒ ss — ʒ ij.

Composition.—When fresh, the root contains a volatile oil, which possesses in a high degree the characteristic odor of the drug. A true active principle has not yet been isolated, yet Conard has obtained a neutral substance, crystallizable, and having a very acrid taste. The so-called *cimicifugin* is nothing more than an impure resin, obtained by precipitation from the tincture by the addition of water. The root contains resin, coloring matters, tannic and gallic acids.

ANTAGONISTS AND INCOMPATIBLES.—As the preparations of cimicifuga contain tannic and gallic acids, they are incompatible with the salts of iron. Stimulants, as alcohol, ammonia, antagonize cimicifuga therapeutically.

SYNERGISTS.—In its action, although feeble, cimicifuga lies between digitalis and ergot. Its physiological effects are increased by cold, digitalis, ergot, belladonna, etc.

PHYSIOLOGICAL ACTIONS.—The taste of cimicifuga is bitter and astringent, with an after acrid feeling. In small doses, without producing any sensible physiological effect, it promotes the appetite and digestion. In full doses it increases the gastro-intestinal secretions. On the heart and circulatory system, cimicifuga has an action not unlike digitalis, but less powerful: it slows the heart-beats but increases their force, and elevates the tension of the arterial system. Its effects on the nervous system, when administered in large doses, are very decided. It causes vertigo, dilated pupils, and in many subjects considerable soporific and anodyne effects. There is little doubt that it increases the contractility of unstriped muscular fiber in a manner that resembles ergot, but much less energetically. It stimulates the venereal appetite in man, and promotes the menstrual flow in women. Diaphoresis and increased bronchial secretion are produced by it, and the urine possesses a distinct odor of the drug.

In order to procure physiological effects from cimicifuga, it is essential that preparations made from the fresh root be employed.

THERAPY.—Cimicifuga is an excellent *stomachic tonic*, and is especially adapted to the treatment of the *irritative dyspepsia of drunkards*. In *fevers* and *inflammatory disorders*, when the action of the heart is quick and the tension of the vessels low, cimicifuga may take the place of digitalis, but it is much less efficient than the latter. It is an *excellent expectorant*, useful in bronchitis and in neuropathic pulmonary disorders. ℞ Ext. cimicifugæ, fl. ℥ ss; tinct. opii deod., ʒ j; syrup. tolu., ʒ xj. M. Sig.: *A teaspoonful every four hours.* This combination is efficacious in *acute catarrh* (common cold), and in *acute bronchitis* after the more active symptoms have subsided. Good results have been obtained from cimicifuga in *phthisis*. It would be idle to claim that it is curative; but, to moderate hectic, to improve the appetite, and to facilitate expectoration, it is undeniably of service. It is in that form of phthisis now called *caseous pneumonia* that cimicifuga can be expected to relieve symptoms, and not in tuberculosis.

Dilated heart, fatty heart, languid circulation, oppressed breathing, general dropsy, are conditions in which cimicifuga takes the *rôle* of digitalis, and although less efficient, is safer, especially in the case of fatty heart.

Most favorable reports have been made of cimicifuga in *acute rheumatism. Chronic rheumatism, with tumefaction of the joints, lumbago, intercostal pain*, and *myalgia*, are disorders affecting the muscular system, in which this drug sometimes succeeds in a wonderful manner; yet it very often fails, and we are, unfortunately, unable to indicate beforehand the particular kind of cases in which it is most beneficial.

The power of cimicifuga to relieve certain kinds of pain is well established. *Neuralgia of the fifth*, arising from cold, *rheumatic headache, ovarian neuralgia*, succeeding to suppressed or arrested menstruation, etc., are forms of pain in which this remedy is frequently very effective.

Puerperal mania, hypochondriasis, and convulsions, due to menstrual irregularities, have been cured by cimicifuga. The greatest successes of this drug have been achieved in *chorea*. It is useful in those cases which arise about the period of puberty, and are connected with disorders or perversions of the menstrual flow.

Cimicifuga relieves the pains of *dysmenorrhœa* when of the congestive variety. *Heat of head, flushings of the face, pain in the head, back, and limbs, quick pulse, and nervousness*, when due to arrest of the monthly flow, are often remarkably benefited by this agent. It has been used to promote *parturient pains*, to induce *uterine contractions* after delivery, and to relieve after-pains, but it is inferior to ergot for most of these purposes. It is serviceable in *subinvolution of the uterus*, and may be given in combination with ergot.

The aphrodisiac effects of cimicifuga render it useful in *spermatorrhœa*. It is not adapted to physiological spermatorrhœa, which is really a condition of normal plethora, but to those cases in which the organs are relaxed, the erections weak, and the seminal discharges feeble and occur on slight excitement.

To obtain curative effects from cimicifuga, it must be administered in sufficiently large doses to produce some of its cerebral or other physiological actions.

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Belladonna.—Deadly nightshade.

Belladonnæ Foliæ.—Belladonna-leaves. The leaves of *Atropa belladonna* Linné (Nat. Ord. *Solanaceæ*), U. S. P. *Feuilles de belladone*, Fr.; *Tollkraut*, Ger.

Belladonnæ Radix.—Belladonna-root. The root of *Atropa belladonna*, as above. *Racine de belladone*, Fr.; *Belladonnawurzel*, Ger.

Emplastrum Belladonnæ.—Belladonna-plaster. (Belladonna-root and resin-plaster.)

Extractum Belladonnæ.—Extract of belladonna. Dose, gr. $\frac{1}{4}$—gr. j.

Extractum Belladonnæ Alcoholicum.—Alcoholic extract of belladonna. Dose, gr. $\frac{1}{4}$—gr. j. Prepared from the leaves.

Extractum Belladonnæ Fluidum.—Fluid extract of belladonna. Dose, ♏ j—♏ v. Prepared from the root.

Tinctura Belladonnæ.—Tincture of belladonna. Prepared from the leaves. Dose, ♏ v—ʒ ss.

Composition.—Belladonna contains a peculiar alkaloid, *atropine*, on the presence of which the physiological activity of the drug depends. This principle is found chiefly in the bark of the root, and of young root. Another principle has also been discovered analogous to atropine, to which the name *belladonnine* has been given. Ladenburg has shown that *belladonnine* is identical with the active principle of hyoscyamus, or *hyoscyamine*. It is identical with atropine in composition, and can only differ in the arrangement of its molecules. The root also contains a fluorescent substance and a coloring matter, which has been called *atrosin*. Atropine exists in the plant in combination with malic acid as *bimalate*.

Atropina.—Atropine. Is in yellowish-white, silky, prismatic crystals, without smell, but having a bitter and acrid taste. It is soluble in three hundred parts of water at 60° Fahr., in twenty-five parts of ether, and in much less alcohol. It has a strong alkaline reaction, and forms crystallizable salts with acids.

Atropinæ Sulphas.—Sulphate of atropine. Is a white, crystalline powder, very soluble in water and in alcohol. Dose, gr. $\frac{1}{120}$—gr. $\frac{1}{60}$.

Atropinæ Salicylas, Atropinæ Hydrobromas.—The salicylate and hydrobromate, especially the former, are preferred to the sulphate by many ophthalmologists.

Antagonists and Incompatibles.—Caustic alkalies act on atropine, and ammonia is evolved; they are, therefore, incompatible with the preparations of belladonna. As respects physiological antagonism, pilocarpus and physostigma counterbalance the actions of belladonna in almost the whole range of its influence, and opium—within certain limitations to be hereinafter described—prevents the respiratory failure, the cause of death.

Physiological Actions.—Dryness of the mucous membrane of the nose, mouth, throat, and larynx, is produced by the direct application of atropine to these parts, and the same effects in a more positive manner follow the stomach or subcutaneous administration. A peculiar bluish appearance of the lips, as well as dryness, the author has frequently observed. Nausea is occasionally produced by belladonna, but this effect is probably due to cerebral disturbance. Dryness of the mucous membrane of the stomach and intestines is doubtless produced by belladonna, but increased secretion occurs subsequently, for the stools are rendered more liquid, and are also voided more frequently. Increased peristalsis is most probably a result of the action of belladonna on the unstriped muscular fiber of the intestines.

The active principle of belladonna (atropine) is an extremely diffusible substance. What changes it induces in the blood, if any, are not known. It affects the circulation in a remarkable manner. In some subjects a decided slowing of the heart takes place immediately after the administration of a considerable dose (atropine hypodermatically) and in all, most probably, an instantaneous retardation of the pulse-rate, but a very decided rise in the number of pulsations quickly follows. Not only is the number of the heart-beats increased, but their vigor also, and the area over which the pulsations are distributed is enlarged. It has been conclusively shown that the increased action of the heart is due, first, to stimulation of the cardiac ganglia of the sympathetic, and, secondly, to a paralyzing action on the pneumogastric terminal filaments. In other words, the motor power of the heart is increased in activity, and the inhibiting control is lessened.

The stimulation of the vaso-motor centers by belladonna, or atropine, causes a general rise of blood-pressure owing to contraction of the arterioles. This action of atropine rapidly produces a state of over-excitation, and the irritability of the vaso-motor nervous system, at first increased, soon diminishes; the action of the heart becomes weak, the vessels dilate, and the blood-pressure falls below the normal. In large medicinal doses this effect is easily seen, and, in lethal doses in animals, it may be most certainly demonstrated.

As regards the function of respiration, atropine increases the number and depth of the respiratory movements, but the increase is not in the same ratio as is the elevation of the pulse-beat. The more rapid action of the heart, the increased respiratory movements, the contraction of the arterioles, result in an increased supply of blood to the periphery, more rapid nutritive changes, and consequent elevation of temperature. The rise in temperature in man, from a full medicinal dose, is from $\frac{1}{2}$° to 1° Fahr. This increased body-heat is not long maintained; with the fall in the blood-pressure (vaso-motor paresis), there ensues a diminution in temperature.

In persons of a light complexion, more especially in women, a full dose of atropine is frequently followed by a diffused redness of the skin, not unlike the rash of scarlatina, but wanting in the punctated character of this specific eruption. Redness of the fauces, and some difficulty of swallowing, owing to the dryness of the mucous membrane, occur at the same time, rendering the similitude to scarlet fever very striking. The flush of atropine succeeds to a marked but temporary pallor, which is the first effect, and is a symptom of the vaso-motor paresis which succeeds to the vaso-motor stimulation. The belladonna rash is sometimes followed by desquamation.

Dilatation of the pupil is a conspicuous effect of atropine. Whether dropped into the eye, introduced into the stomach, or injected under the skin, prompt and decided dilatation of the pupil follows. A much smaller quantity suffices to produce this effect, when applied directly to the eye. Paresis of the muscle of accommodation is caused by atropine, and this agent also lessens the intraocular pressure. It has been conclusively shown that atropine produces these remarkable effects by an action on the peripheral filaments of the nerves of the iris, and not on its muscular fibers; atropine paralyzes the oculo-motor nerve end-organs, and stimulates those of the sympathetic.

The cerebral effects of belladonna are very characteristic. Headache, vertigo, illusions, hallucinations, a busy delirium, sometimes somnolence, are produced by large doses. The vision is usually lost, the pupils are dilated to the utmost, the eyes are brilliant and staring. Muscular weakness, inco-ordination, and complete motor paralysis occur; but sensation is not destroyed; although occupied with fancies and illusions, the patient may be indifferent to moderate irritation. The delirium which occurs has a peculiar character: it may be gay and laughing, or busy, the patient being incessantly occupied with a single object or idea; or it may be noisy and furious, the patient fighting and striking all who approach. In lethal doses convulsions may occur, or profound stupor may result after a period of delirious excitement.

The voluntary muscles are not affected by belladonna. The muscular paresis which results from the administration of this drug is due to its action on the motor nerves, but the excitability of these nerves is diminished only, and not wholly destroyed. Both the motor-nerve trunks and the end-organs are affected. The sensibility of the sensory nerves is also impaired, but is not diminished to the same extent as is that of the motor nerves.

Although the action of belladonna is so largely paralyzant, it is not exclusively so, and, under certain circumstances, a tetanic action very similar to that caused by strychnine is developed. In frogs, a day or two after the induction of paralysis by the subcutaneous injection of atropine, the tetanic state occurs. When this state is reached, although the frog lies perfectly limp and motionless if undisturbed, an irritation applied to the periphery will at once cause general tetanic rigidity and spasms. The author was the first to show that this condition of the nervous system is attained in frogs an hour or two after the conjoined administration of atropine and physostigma (*eserine*).

Atropine, by virtue of the greater than normal transmission of blood through the tissues, increases metamorphosis, and the results of this are represented in an increased elimination of the products of waste.

Atropine is eliminated chiefly by the urine, and the urine of an atropinized animal will dilate the pupil of another animal.

THERAPY.—In *mercurial ptyalism*, and the *ptyalism of the pregnant state*, a few drops (five to ten) of the tincture of belladonna, given every four to six hours, or a corresponding quantity of atropine, will cause the excessive secretion to diminish, and even dry up, and will thus relieve a very disagreeable symptom. *Gastralgia*, as well as the pain which accompanies *gastric ulcer*, is often happily relieved by atropine. ℞ Atropinæ sulphatis, gr. j; zinci sulphatis, ʒ ss; aquæ destil., ℥ j. M. Sig.: *From three to five drops twice or thrice a day.* A similar combination is very effective in *pyrosis, chronic gastric catarrh*, and *irritative dyspepsia*. Atropine is frequently effective in relieving the *vomiting of pregnancy*. ℞ Atropinæ sulphat., gr. ij; aquæ destil., ℥ j. M. Sig.: *Two drops in water before meals.* It is often more useful when applied to the rectum in the form of suppository. It sometimes gives great relief when applied to the epigastrium in chloroformic solution. ℞ Atropinæ, gr. v; chloroformi, ℥ j. M. Sig.: *A piece of lint to be moistened with the solution and laid on the epigastrium.*

The extract of belladonna is a useful addition to purgatives, to diminish the harshness and at the same time to increase the effectiveness of their operation. Belladonna has the power to increase the peristaltic movements and to allay irregular or spasmodic movements. It is, therefore, used to overcome *habitual constipation*. A pill containing a half-grain of extract, taken at night, will sometimes succeed, but it is generally better to combine it as follows: ℞ Ext. belladonnæ, ext. nucis vomicæ, ext. physostigmatis, āā gr. iij. M. Ft. pil. no. vj. Sig.: *One at bed-hour.* An addition of a half-grain of aloin will, of course, increase the action of this pill, and may be added when there are great torpor and inaction of the intestines.

When, in affections of the gastro-intestinal apparatus, acids are indicated with atropine, they may be combined as follows: ℞ Acid.

muriat. dil., ℥ j; atropinæ, gr. ss. M. Sig.: *Five drops in water before meals.* Such a prescription is useful in *heart-burn*, *water-brash*, etc.

Harley advises the use of atropine as a *cardiac stimulant;* but the fact that this agent exhausts the irritability of the cardiac ganglia after a period of excitement requires discrimination in its use. Notwithstanding this objection, atropine may be given to counteract a sudden and temporary depression in the heart's action—as, for example, in the collapse of cholera, in which it has been employed successfully by the hypodermatic method.

Belladonna is a remedy of great efficacy in certain *acute inflammations* of the air-passages. No remedy gives such prompt and sustained relief in *acute nasal catarrh with profuse watery secretion.* To adults, the best method of administration consists in giving a first dose of five drops of the tincture, and repeating a drop or two drops every hour until atropinism is produced. This remedy is also very admirably adapted to the treatment of *ordinary sore-throat.* As a constant physiological action of belladonna is redness and dryness of the fauces, its therapeutical action, in sore-throat with increased secretion, is antipathic or substitutive; or, as it may be more scientifically expressed, the action of belladonna is the physiological antagonist of the disease-action. When there is much fever it is useful to combine aconite with belladonna. ℞ Tinct. aconiti rad., ʒ j; tinct. belladonna, ʒ ij. M. Sig.: *Four drops in water every hour or two.* That form of *aphonia* which is due to fatigue of the vocal cords may be removed very speedily by a morning and evening dose ($\frac{1}{120}$—$\frac{1}{80}$ of a grain) of atropine. Not unfrequently *hysterical aphonia* may be quickly cured in the same way.

There is much to be expected from the use of belladonna preparations in *whooping-cough.* The best form for administration is a solution of the sulphate of atropine (gr. j—℥ j of water. Dose, ♏ ij—♏ iv). This remedy is not adapted to all cases, and is most effective in the spasmodic stage. In order to be curative, physiological effects must be produced. The good results of atropine in whooping-cough are most obvious in those cases characterized by profuse bronchial secretion.

Belladonna gives great relief in paroxysms of *asthma*, and in the spasmodic difficulty of breathing which accompanies emphysema. According to the author's observation, when the bronchial mucous membrane is deficient in secretion, the pulse much accelerated, the skin dry and hot, belladonna rather adds to the distress; and its good effects are most conspicuous when there are abundant expectoration, a cool and moist skin, and a quiet pulse of low tension. In asthma, atropine may be injected subcutaneously, or the belladonna-leaves be used by the method of fumigation. Belladonna-leaves, dipped in a saturated solution of niter and then dried, may be burned in a close apartment, the patient breathing the fumes until relief is obtained. Pastiles are made of belladonna, stramonium, poppy, tobacco, etc. A good formula for cigarettes is the following (Trousseau): Belladonna, grs. v; stramonium and hyoscyamus, of each grs. iij; extract of opium, $\frac{1}{2}$ of a grain; cherry-laurel water, a sufficient quantity. The leaves are moistened with a solution of the opium in the cherry-laurel water, and when dry made into a cigarette. Two to four of such cigarettes may be smoked daily. When the paroxysms of asthma occur in the morning, they may sometimes be prevented by the one sixtieth of a grain of atropine at bedtime.

The remarkable similarity in the symptoms of atropinism and of *scarlatina* has led to the use, by homœopathic practitioners, of belladonna as a *prophylactic against this disease.* The points of resemblance are so superficial, and the differences so wide, that no more striking instance could be adduced of the uncertainty in the application of the homœopathic dogma, even admitting its truth. The author is convinced that the so-called prophylactic power of belladonna against scarlatina has no real existence. He has seen too many cases of scarlatina occur in subjects who had been given the remedy freely, to permit him to come to any other conclusion. Belladonna is a useful remedy to relieve some of the symptoms in scarlatina. During the stage of eruption it is indicated when the pulse is feeble, the bodily powers are depressed, and the rash is imperfectly evolved. In this condition of things—in which carbonate of ammonia is so much used—belladonna also renders most important service; but it should not be forgotten that these agents are chemically incompatible, and should not, therefore, be prescribed together.

In *diphtheria*, when there is much depression, belladonna is a most excellent remedy. If given before the exudation has spread and consolidated into membranous plaques, and when a few patches only have appeared on the tonsils, or soft-palate, it seems to have the power to hinder the formation of the exudation.

There is no doubt that belladonna has a real curative power in *erysipelas.* It is especially adapted to *idiopathic erysipelas,* notably to *facial erysipelas,* and is less serviceable in traumatic erysipelas. Homœopathists explain this on the doctrine of similars, but the action is really one of antagonism, or substitution. When there is much fever, digitalis or aconite may be combined with belladonna with advantage, and when there is much depression, quinine. ℞ Quininæ sulph., ʒ ss; belladonnæ extract., grs. iij. M. Ft. pil. no. x. Sig.: *One every four or six hours.*

Excellent results have been obtained from the use of belladonna in *typhus and typhoid fevers.* Graves originally suggested an indication for its use in fevers, which is doubtless serviceable, viz., contracted pupils; but belladonna has been used, irrespective of this sign, by other practitioners with great success. The tincture is a suitable preparation, and of this from five to ten drops every four hours is a proper dose. According to the author's observation, belladonna is indicated when there is much low, muttering delirium, subsultus, and stupor, and is contraindicated in the condition of delirium ferox.

Belladonna has important application in the treatment of certain disorders of the nervous system. *Sick-headache*, due to or accompanied by spasm of the arterioles—a condition manifested by pallor of the face, vertigo, and *tinnitus aurium*—is relieved by belladonna. At first the distress may be even increased, but great relief presently follows. This remedy is injurious in the congestive form of sick-headache. The following is a serviceable combination in the cases of sick-headache due to vaso-motor spasm: ℞ Atropinæ sulph., gr. ss; chinoidin, ʒ j. M. Ft. pil. no. lx. Sig.: *One pill twice or thrice a day.*

Although belladonna in the physiological state induces wakefulness and busy delirium, in certain morbid states of the brain it is *hypnotic.* The indications for its use are as follows: prostration, low state of the arterial tension, languid intra-cranial circulation, a contracted pupil, and insomnia, due to the condition of the brain manifested by these objective signs. In various kinds of *mental disorder*, in which the foregoing symptoms are present, much good may be expected from the use of belladonna in moderate doses; but harm only will be produced by it when there is much vascular excitement.

Belladonna, according to Trousseau and Pidoux, is a more efficient remedy in the treatment of *epilepsy* than the salts of silver, copper, or zinc. They insist that the capital condition of success is perseverance on the part of the physician and patient, that belladonna should be given steadily for a year in gradually-increasing doses, and that if amendment is then produced it should be continued through two, three, or even four years. Belladonna is not equal to bromide of potassium in cases of diurnal epilepsy, in epilepsy accompanied by cerebral hyperæmia, and in epileptiform convulsions due to coarse organic lesion of the brain. The best results are obtained from it in nocturnal epilepsy, in *petit mal*, and in pale, delicate, and anæmic subjects, with cold hands and feet, blue skin, and weak heart.

In *neuralgia* belladonna affords relief, although not equal to some other agents. Given *hypodermatically* (*see post*), it is often very effective. In any case, its use must be persisted in; full doses are necessary, and physiological effects must be produced and maintained for some time. A solution of atropine is the best form for the stomach administration. *Dysmenorrhœa*, when neuralgic in character, and *ovarian neuralgia*, may be permanently removed by belladonna. It is useful in these cases to combine it with synergistic remedies. ℞

Ext. belladonnæ, grs. iv; ext. stramonii, grs. v; ext. hyoscyami, grs. v; quininæ sulphat., ℈ij. M. Ft. pil. no. xx. Sig.: *One pill two or three times a day.* When anæmia exists, iron may be added to this formula.

No single agent has been as uniformly successful in the treatment of *nocturnal incontinence of urine* as belladonna. This morbid state is due to several conditions, and belladonna is not equally successful in all: nocturnal incontinence may be due to an excess in the acidity of the urine, which renders it unduly stimulating; to relaxation of the sphincter vesicæ; to an irritability of the mucous membrane, in consequence of which erroneous impressions are communicated to the brain. Belladonna gives relief in the two last-named conditions. The atropine dissolved in the urine acts locally on the nerves of the mucous membrane, diminishing their irritability; the sphincter is put into a state of tonic contraction by reason of the systemic effect, which includes, of course, the sympathetic system. The error is often committed of giving too little of the remedy; systemic effects must be produced, and children, compared with adults, are insusceptible to the action of belladonna. The best form for administration, because less disagreeable and more constant in effect, is a solution of atropine.

Nocturnal seminal losses, as respects mechanism of production, making allowance, of course, for difference of seat, have a strong analogy with nocturnal incontinence of urine. This trouble may be considered a morbid state, only, when the losses are frequent and affect the health. Bromide of potassium best relieves spermatorrhœa, so called, when it is largely physiological and due to a normal plethora; belladonna is most serviceable when the genitalia are relaxed, the emissions flowing without force, and without a distinct dream and orgasm.

Atropine is a remedy of the greatest importance in the *practice of ophthalmology.* As it dilates the pupil, diminishes the intraocular pressure, contracts the arterioles, and acts topically on the sentient nerves, it is obvious that its field of utility is wide, and its therapeutic power great.

In *phlyctenular keratitis* atropine renders the greatest service; it diminishes the photophobia and blepharospasm, and lessens the blood-supply by contracting the vessels. It has a still more beneficial action in *iritis;* it prevents adhesions, anterior and posterior, and by dilatation of the pupil so compresses the vessels as to jugulate the inflammatory process. When the cornea is perforated, herniary protrusion and adhesion of the iris are prevented by dilating the pupil. For these purposes a four-grain solution of atropine is the proper strength for instillation into the eye. When it is desirable to suspend the power of accommodation, in cases of *hypermetropia* to determine the refraction of the eye, and in *astigmatism* to ascertain the difference in the meridians, atropine is used. A weak solution only is employed, to dilate the pupil for a brief period, in order to facilitate the examination of the fundus of the eye. Dilatation of the pupil with atropine is also necessary in the examination of *cataract*, especially in the early stages of its formation. It should be remembered that strong solutions of atropine instilled into the eyes may, by subsequent absorption, produce atropinism, and to such an extent as to occasion solicitude.

In certain *affections of the skin* belladonna is useful—viz., in the *cutaneous neuroses, prurigo, herpes zoster, erythema,* and *eczema*, etc. Cases of these affections which resist ordinary treatment, yield to belladonna. The tincture, or the alkaloid, in suitable doses, may be given in quantity sufficient to maintain a slight physiological action. *Hyperidrosis* (colliquative sweating), *unilateral sweating*, and other forms of profuse transpiration through the skin, are arrested by the internal and, in some cases, by the local application of the belladonna preparations, as Ringer has shown.

No remedy is so generally effective in relieving the *sweats of phthisis* as atropine. The one sixtieth of a grain at bedtime usually suffices. The author was the first to indicate this use of atropine in his "Prize Essay." Not only is atropine antagonistic in action to that condition of the sudoriparous glands resulting in the sweats of disease, but it equally antagonizes the hyperidrosis produced by such drugs as jaborandi.

In the treatment of that form of phthisis known as *caseous pneumonia*, atropine has an important place, quite irrespective of its power to arrest the sweats. As Dr. Fothergill, of London, and myself, nearly simultaneously ascertained, it has an influence on the progress of these cases, and a curative effect that is often very remarkable. The author has observed with regret that some of those who have found this remedy useless, were entirely mistaken as to the character of the cases in which atropine has proved beneficial. As a remedy for the caseous inflammation, without regard to sweating, the period when the degree of benefit above referred to may be expected from it, is the stage of deposit immediately succeeding the stage of catarrhal inflammation, and before softening and extrusion, and not in tuberculosis.

HYPODERMATIC USE OF ATROPINE.—The solution usually employed for this purpose is two grains of the sulphate of atropine to an ounce of distilled water, the dose of which ranges from one to five minims.

There are two forms of *neuralgia* in which the subcutaneous use of atropine has been most signally useful: *tic-douloureux* and *sciatica*, more especially the latter. Atropine is not as effective in the treatment of the neuralgias in general as morphine, and the systemic effects of the former are much more unpleasant than those caused by the latter. Nevertheless, when morphine fails or disagrees with the patient, atropine may be used with confident expectation of its affording relief. We owe to Hunter our knowledge of the fact that atropine has a very special utility in *tic-douloureux* and *sciatica*. The merely subcutaneous injection of atropine does not afford the same degree of relief as its deep injection in the neighborhood of the affected nerve-trunk. Furthermore, a decided impression must be made on the cerebrum, in order to obtain the best results. The largest doses compatible with the safety of the patient must be used—generally the one fiftieth of a grain to the one thirtieth. If the remedy is employed in sufficient quantity, and well inserted into the tissues above the nerve, decided curative results may be expected from it in these two forms of neuralgia. When relief follows the injection of atropine, it is apt to be more permanent than when the same degree of relief is obtained from morphine. We have the high authority of Dr. Anstie for the assertion that atropine is exceptionally serviceable in *peri-uterine* and *dysmenorrhœal neuralgia*. Dr. Weir Mitchell asserts that atropine in *traumatic neuralgias* is "simply useless," and, as his power of accurate observation is unquestioned, and his clinical opportunities vast, we may accept this conclusion as final.

Muscular cramp, from injuries to the nerve-trunk, are often remarkably relieved by injections of atropine into the substance of the affected muscles. The so-called "late rigidity," as the result of which the members may be put into very injurious positions, is occasionally removed or diminished by the same expedient—viz., injecting a small quantity of atropine ($\frac{1}{125}$ of a grain) into the contracted muscles. This result does not ameliorate the condition of the patient to any greater extent than that of affording relief to an inconvenient deformity.

The *insomnia of mental disorders*, and of *delirium tremens*, may be overcome by the hypodermatic injection of atropine when the following indications for its use are present: Coma vigil, great restlessness, weak action of the heart, coldness of the surface, cyanosis, clammy sweat. When there is a condition of hyperæmia of the cerebro-spinal centers, excitement with elevated pulse-rate and increase of arterial tension, atropine can only do harm.

The treatment of *asthma* by belladonna, administered by the stomach and in the form of fumigation, has already been referred to. The hypodermatic injection of atropine is much more effective. From $\frac{1}{120}$ to $\frac{1}{60}$ of a grain may be used for this purpose; but, as the relief comes from the systemic effect, it is not necessary to inject the solution in the neighborhood of the pneumogastric, as practiced by Courty. In order to procure the greatest relief, the injection should be made at the beginning of the asthmatic paroxysm, and succeeding attacks should be anticipated by inducing atropinism at the first warning of a seizure.

Vomiting of pregnancy, when obstinate and resisting other means, is sometimes arrested promptly and permanently by the subcutaneous injection of atropine in small quantity ($\frac{1}{120}$ of a grain). *Sea-sickness* is relieved in the same way. In these maladies, it is better to insert the injection in the epigastrium.

Cramp of the hollow muscular organs—*hepatic, intestinal, uterine, and renal colic*—may all be relieved by the subcutaneous injection of atropine, but the most satisfactory results are produced by the combined use of atropine and morphine.

EXTERNAL APPLICATION OF BELLADONNA PREPARATIONS.—The chloroformic solution of atropine is an excellent external application *to relieve pain* in nerves superficially situated. ℞ Chloroformi, spts. vini rect., āā ℥ ss ; atropinæ, grs. v. M. Sig.: *Apply on lint to painful part, and cover with oiled silk.* The same application to the epigastrium sometimes arrests *obstinate vomiting*, cerebral or reflex, as, for example, the *vomiting of pregnancy, sea-sickness*, etc. A belladonna-plaster is an excellent application to relieve the *chest-pains of phthisis, to allay irritability of an over-excited heart*, to diminish the pains and soreness of *lumbago, myalgia*, etc.

Excessive sweating of a part, as, for example, *unilateral sweating of the head*, may be removed by brushing over the affected surface a solution of atropine (grs. iv—℥ j).

There is no doubt that belladonna has the power to arrest the secretion of milk, in the same way that it stops the cutaneous transpiration, for the milk-gland is only an enlarged sebaceous gland whose function is differentiated from that of other sebaceous glands of the body. When it is desirable *to arrest the secretion of milk*, the gland may be enveloped by a belladonna-plaster, or the ointment of belladonna may be carefully rubbed into the integument. These are rather disagreeable, sticky applications, which soil the clothing. A much more elegant method of applying this treatment is to envelop the breast in lint wet with a solution of atropine, four grains to the ounce of rose-water. As systemic effects may be produced by such an application, when the pupils dilate and the mouth becomes dry, it should be removed. *Inflamed breasts* may be treated in the same way. The mode of action of the belladonna preparations is quite obvious: the irritability of the terminal filaments of the nerves is allayed by the direct action of the atropine, and the arterioles are made to contract, thus diminishing the blood-supply to the inflamed tissue.

Other superficial inflammations are subdued by the same treatment, as, for example, *abscesses, boils, carbuncles*. A plaster made of belladonna extract may be kept in contact with the inflamed tissue, or the solution of atropine, above recommended, may be used.

Pruritus of the vulva, vaginismus, fissure of the anus, are sometimes relieved, as if by magic, by the use of the atropine solution above recommended.

Whenever atropine is used locally for the relief of inflammatory pain and swelling, the efficiency of the application is much increased by the addition of morphine, or morphine and chloral, according to formulæ to be given hereafter in the article on the latter drug.

SECONDARY PRODUCTS OF ATROPINE.—Some remarkable products have lately been obtained from atropine by chemical processes. The first step consisted in the discovery, by Kraut and Lossen, simultaneously, that atropine may be split up into *tropine* and *tropic acid.* Subsequently, Prof. Ladenburg succeeded in the synthesis of atropine by a combination of these two secondary products. If the salts of tropine are treated with dilute hydrochloric acid, alkaloids are produced, to which Ladenburg has given the name *tropeins. Homatropine* is an alkaloid obtained from the amygdalate of tropine. The artificial atropine, prepared as above described, has precisely the same effects as the original alkaloid.

Effects of Homatropine.—The preparation of this base now used is the hydrobromate. The physiological action of this new salt has been studied by Ringer and Tweedy, among others. Ringer finds that, like atropine, homatropine paralyzes and tetanizes, but the tetanizing effect, which follows in forty-eight hours or more in the former, occurs at once in the latter. The paralyzing action is not in the nerves or muscles, for they respond to electrical stimulation, but in the cord, which is also the case with atropine. Homatropine, like atropine, increases the action of the heart by paralyzing the intra-cardiac inhibitory apparatus, and it also antagonizes muscarine. In man there is a marked distinction as regards the action of atropine and homatropine on the heart: while the former accelerates the heart considerably, the latter retards the beat from ten to twenty per minute, and also makes the action irregular. Homatropine also antagonizes the action of pilocarpine, but it requires relatively more than of atropine to accomplish this result. Ringer sums up his observations with the remark, "Homatropine, then, appears to possess many of the properties of atropine, but in a weaker degree."

Tweedy remarks that, as regards the action of atropine and homatropine relatively on the eye, the effect of homatropine on the iris and ciliary muscle is really very powerful while it lasts. It widely and fixedly dilates the pupil in from fifteen to twenty minutes, and it acts on the accommodation in an equally rapid manner. Its effects pass off rapidly, and in twenty-four hours the accommodation is restored, although the pupil is yet a little dilated. The application of homatropine solution to the eye is entirely unirritating. For these reasons homatropine becomes a valuable substitute for atropine in ocular therapeutics, but it can not be substituted for atropine in the general diseases in which the latter has been found useful.

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Stramonium.—Leaves and seed of *Datura stramonium* Linné (Nat. Ord. *Solanaceæ*). *Stramoine*, Fr.; *Stechapfel*, Ger.

Stramonii Folia.—Stramonium-leaves.

Stramonii Semen.—Stramonium-seed.

Extractum Stramonii Seminis.—Extract of stramonium-seed. Dose, gr. ⅙—gr. ss.

Tinctura Stramonii Seminis.—Tincture of stramonium-seed. Dose, ♏v—ʒ ss.

Extractum Stramonii Seminis Fluidum.—Fluid extract of stramonium-seed. Dose, ♏j—♏v.

COMPOSITION.—The alkaloid of stramonium—*daturine*—is chemically and physiologically nearly identical with *atropine*. It is contained in the seeds in the proportion of about one tenth per cent, and in the leaves in much smaller quantity. It exists in the plant in combination with malic acid. The seeds contain a fixed oil in considerable quantity.

ANTAGONISTS, INCOMPATIBLES, and SYNERGISTS, are the same as for belladonna. In the case of poisoning by stramonium, which is not uncommon in this country, the seeds, which usually are taken by children, must be evacuated by an emetic. Unless distinct symptoms follow, no further treatment may be necessary; if, however, marked dilatation of the pupil, hallucinations, and active delirium are produced, the physiological antagonist becomes necessary. Tincture of opium should be administered until some contraction of the pupil, lessening of the pulse-rate, and cessation of the delirium, occur. If, then, normal sleep comes on, the pupil, heart, and lungs functionating normally, no further interference will be necessary. In cases of poisoning in children, it is particularly desirable to employ the opium with caution, since opium narcosis may readily be substituted for stramonium-poisoning.

Hyoscyamus.—The leaves and flowering tops of *Hyoscyamus niger* Linné (Nat. Ord. *Solanaceæ*), collected from the plants of the second year's growth. *Jusquiame*, Fr.; *Bilsenkraut*, Ger.

Extractum Hyoscyami Alcoholicum.—Alcoholic extract of hyoscyamus. Dose, gr. $\frac{1}{6}$—gr. j.

Extractum Hyoscyami Fluidum.—Fluid extract of hyoscyamus. Dose, ♏v—ʒ ss.

Tinctura Hyoscyami.—Tincture of hyoscyamus. Dose, ʒ ss—℥ ss.

Composition.—Hyoscyamus contains two active principles—*hyoscyamine* and *hyoscine.*

Hyoscyaminæ Hydrobromas.—Hyoscyamine hydrobromate. A yellowish-white, amorphous, resin-like mass, or prismatic crystals. Very soluble in water (0·3 part) and in alcohol (2 parts). Dose, gr. $\frac{1}{60}$—gr. $\frac{1}{4}$.

Hyoscycaminæ Sulphas.—Hyoscyamine sulphate. In white, indistinct crystals, or a white powder, without odor and having a bitter, acrid taste. Freely soluble in water (0·5 part) and in alcohol (2·5 part). Dose, gr. $\frac{1}{60}$—gr. $\frac{1}{4}$.

Hyoscinæ Hydrobromas.—Hyoscine hydrobromate. In colorless, transparent, rhombic crystals, odorless and having an acrid, slightly bitter taste. Soluble at 59° Fahr. in 1·9 parts of water and in 13 parts of alcohol. Dose, gr. $\frac{1}{80}$—gr. $\frac{1}{10}$.

Antagonists, Incompatibles, and Synergists are the same as for belladonna. The observation of Ladenburg, that hyoscyamine and duboisine are identical, is important, and, if confirmed, will facilitate the introduction of the latter into practice. As hyoscyamine is difficult to procure and very expensive, and as duboisine, on the other hand, will probably be very readily procured in any quantity, the latter may be substituted for the former. Clinical facts of this kind must be acted on with caution. Identity of chemical constitution does not always mean identity in physiological action and in therapeutical power. Differences in molecular arrangement, not appreciable by chemical analysis, may influence, to a great extent, the mode of action. The clinical facts do not, thus far, warrant the adoption of the view that hyoscyamine and duboisine are mutually convertible.

Physiological Actions.—As atropine, daturine, and hyoscyamine are similar if not identical in chemical composition and in physiological action, the remarks already made in regard to the actions and uses of belladonna are applicable to stramonium and hyoscyamus.

To these alkaloids must be added duboisine, which by Ladenburg is held to be identical with hyoscyamine. Studied from the physiological standpoint, daturine and hyoscyamine are regarded as identical in their effects by Oulmont and Laurent. As daturine is not employed, owing to its scarcity, and as hyoscyamine has been the subject of considerable study and clinical observation, we refer, in the following remarks, wholly to this alkaloid.

Hyoscyamine, as it occurs in commerce, prepared chiefly by Merck, of Darmstadt, is in two forms, a yellowish-white crystalline solid, which is represented as chemically pure, and a dark, resinous mass, having a strong, mouse-like odor, which is rather a concentrated extract, but appears to be little if at all inferior to the pure alkaloid, and consists, as is now known, for the most part, of hyoscine, and is necessarily as active as any salts of the alkaloid. It may be administered hypodermatically in this form. As now the salts of hyoscyamine are used, and are freely soluble, water is the only menstruum employed to make solutions. The hydriodate is, however, the best form for administration, as it is freely soluble in water. The great variations in the dose of the alkaloid are due to the fact that much of the supposed residual extract is merely the uncrystallized hyoscine. The dose, by subcutaneous injection, ranges from one sixtieth of a grain to one fourth, and by the stomach from one sixtieth to one grain.

Hyoscyamine causes the same dryness of the mouth, dilatation of the pupils, flushing of the face, rapid action of the heart and of the lungs, the busy delirium with hallucinations and illusions, which are caused by atropine, but its effects in these directions are less in degree. In the various observations which have now been made on man, with the considerable doses which have been found necessary in some cases, it has been definitely ascertained that hyoscyamine has somewhat less than atropine of the deliriant action and much more hypnotic effects. As regards the mechanism of its action on the pupil, on accommodation, on the heart and respiration, there is no actual difference between the two alkaloids.

The elaborate investigations of MM. Oulmont and Laurent have conducted them to the following conclusions: Hyoscyamine and daturine act especially on the sympathetic system, in small or moderate doses stimulating the vaso-motor fibers and raising the arterial tension, and in large doses paralyzing the vessels and lowering the arterial tonus. These effects are produced after section of the vagi. The alkaloids differ in their action on the heart—hyoscyamine rendering the cardiac movements more regular, and daturine causing intermittence. By direct contact, both alkaloids slow and finally stop the heart's action. Both accelerate the respiratory movements. In moderate quantity both increase the intestinal movements; in large doses arrest them. As regards the nervous system of animal life, they are both without action on the motor functions, but in toxic doses they blunt the cutaneous sensibility. They do not affect the contractility of muscular fiber. Their action in dilating the pupil is due to stimulation of the sympathetic, and not to paralysis of the third nerve. The various phenomena arising from the administration of these alkaloids are referred by Oulmont and Laurent to the circulatory disturbances—to the increased distribution of blood. The action is soon ended, the alkaloids being eliminated by the urine rapidly.

Notwithstanding the freedom with which hyoscyamus and its alkaloid, hyoscyamine, are given, rarely are there any unpleasant effects. Empis, however, has reported some cases in which toxic symptoms happened from medicinal doses. These must have been examples of idiosyncrasy, for in the discussion which ensued, Joffroy, Damaschino, and others, expressed themselves strongly against the probability of serious effects from doses within safe limits.

THERAPY.—The possession of decided hypnotic qualities has led to the use of hyoscyamine and hyoscine in the treatment of various *mental disorders* (Prideaux, Lawson, and others). Prideaux makes the important practical distinction, that it acts with different degrees of rapidity and potency under varying conditions of insanity. In *acute mania* with depression, one sixteenth of a grain will have a marked effect, while in the excitement of chronic mania large doses will be necessary. In *chronic mania* with exacerbations, he gives one quarter, one half, and even one grain by the stomach, or one tenth of a grain subcutaneously. The latter mode of administration he regards preferable in these cases. In cases of mania with great motor excitement, and of a destructive character, Prideaux regards hyoscyamine as "the most rapid and reliable narcotic we possess." In the *epileptic mania* of the epileptic status, he says, it diminishes the number and violence of the attacks. In *delusional insanity* he finds it brings about, under favorable circumstances, mental restoration. In *chronic dementia*, with destructive tendencies and sleeplessness, improvement is sometimes noted from the persistent use of small doses. Reinhard also has administered this agent in the dose of a milligramme (about one sixty-fifth of a grain) subcutaneously in cases of *mania* and *epilepsy*, with distinctly good results. In eight of fifteen cases of mania, calmative effects were produced and permanent good was accomplished; and in five of twelve epileptics with maniacal attacks, the number and severity of the seizures were lessened. Drs. Sapilli and Riva, eminent Italian alienists, have found hyoscyamine very useful in *recurrent mania*. Gill, Ringer, and Lawson have also had good effects from hyoscyamine, in suitable cases, as an hypnotic.

Stramonium and hyoscyamus may be used like belladonna for the relief of painful affections, the *neuralgiæ;* but they possess no special advantages over their more powerful congener. Oulmont has used the hypodermatic injection of hyoscyamine with remarkable success in several cases of neuralgia, but he does not regard it as more conspicuous and rapid in this disease than are opium and belladonna. Stramonium is used with advantage in the treatment of *dysmenorrhœa.* ℞ Ext. stramonii, ext. hyoscyami, ext. opii, āā gr. vj. M. Ft. pil. no.

xij. Sig.: *One pill every three, four, or six hours.* This combination gives great relief in dysmenorrhœa, and may also be serviceable in neuralgia.

In affections characterized by *spasm*, as *asthma*, *laryngeal cough*, *hepatic*, *intestinal*, *renal*, and *uterine colic*, stramonium and hyoscyamus may be given with advantage, in place of or in combination with belladonna. The hypodermatic injection of hyoscyamine or daturine is an excellent expedient for procuring relief in these cases, but these alkaloids are not more effective than atropine. Hyoscyamus, especially in the form of tincture, is frequently prescribed in *irritable states of the bladder* due to the presence of stone, enlargement of the prostate, and in catarrh of the bladder arising by transference of irritation from the urethra. It should not be forgotten that liquor potassæ, so much prescribed in a mixture with hyoscyamus, is incompatible.

M. Oulmont refers, in terms which may seem to be exaggerated, to the great efficiency of hyoscyamine in the treatment of *mercurial tremor*, *senile tremor*, *paralysis agitans*, *locomotor ataxia*, and *tetanus*. In *mercurial* and *senile tremor* cures were obtained, but, as might be expected, only amelioration in *paralysis agitans*, *locomotor ataxia*, and *tetanus*. The remarkable benefit obtained from this remedy in paralysis agitans is testified to by Empis, Joffroy, Charcot, and many other observers. The dose which Oulmont found effective was the one thirty-second of a grain of hyoscyamine, gradually increased to the one fifteenth of a grain.

The *hypnotic quality* is much more conspicuous in hyoscyamus than in belladonna or stramonium. In children it has long been known that, when opium is not well borne, hyoscyamus is an efficient substitute. Recent experience in asylum practice has shown that hyoscyamus in large doses is a very valuable hypnotic. According to Dr. Campbell, two and a half drachms of the tincture are equivalent in hypnotic power to thirty grains of chloral hydrate. In order to procure efficient hypnotic effects, from two drachms to an ounce of the tincture is necessary, and this large quantity appears to be free from danger.

Extract of hyoscyamus is used in *combination with purgatives*, with the object—which abundant clinical observation confirms—of rendering their operation more efficient, no doubt, because of its action on the muscular layer of the intestine.

The ointment of stramonium is a favorite application to *irritable ulcers*, *superficial inflammations*, etc.

Hyoscine.—This is a new alkaloid obtained from the mother-liquor, as already shown, and which has been produced synthetically by Ladenburg. It forms a crystalline combination with hydriodic acid, and an amorphous salt with hydrochloric. These salts dissolve freely in water. The solution employed by Edfelsen for administration by the stomach contained about $\frac{1}{10}$ gr. to the tablespoonful, and for subcutaneous injection, $\frac{1}{100}$ gr. to one minim. These are suitable doses for administration.

The physiological effects of *hyoscine* have been studied by Ladenburg, the discoverer; by Edfelsen, and others. Generally speaking, the effects of this agent correspond quite closely to those of atropine, but in corresponding doses the latter is more powerful. When administered subcutaneously, hyoscine acts in two to twelve minutes; by the stomach in about fifteen minutes. It causes more drowsiness and sopor, and less delirium than atropine, but like the latter dilates the pupil, increases the rate of the cardiac and respiratory movements, and reddens the skin. According to Gnauck, the pulse is first slowed eight to twenty beats per minute, and after ten to twenty minutes rises. The same phenomenon is observed from atropine in some subjects, but is not so pronounced. Dilatation of the pupil does not always occur after the stomachal administration. Sleep comes on in twenty to thirty minutes, preceded by a feeling of lassitude, and is deep and quiet, but is followed by headache and vertigo. As a cerebral sedative, Bruce assigns it to a high place, but a period of excitement prefaces the decline of action, and hence a true statement of its powers can be made when both stages of its action are duly accounted for.

Instilled into the eye, hyoscine is a more energetic mydriatic than atropine, dose for dose (Emmert). One part of the hydriodate to one thousand of water is the solution used by Emmert, and this he finds more active than a half-per-cent solution of atropine.

Hyoscine has been employed in various diseases requiring a soporific and anodyne agent. In general, it can be used in the same cases as atropine, but, as it possesses more decided antispasmodic effects, it may prove more valuable. By Ladenburg it has been used successfully in *whooping-cough*, in *asthma*, and in *enteralgia*. Half the cases of whooping-cough were relieved, and all of the cases of asthma were more or less benefited, some decidedly so.

In ophthalmic practice, hyoscine can be substituted for atropine. It causes more prompt and decided, but less persistent, dilatation of the pupil, and it is less poisonous (Emmert). It is applicable to the same purposes in eye-diseases as those in which atropine is now employed.

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Duboisia.—*Duboisia myoporoides*, of the *Solanaceæ*.

Preparations.—There are no official preparations; but the following can be employed in any of the cases requiring it:

Extractum Duboisiæ. Dose, gr. $\frac{1}{6}$ to gr. $\frac{1}{2}$.

Duboisinæ Sulphas, or Hydrobromas.—Dose, gr. $\frac{1}{100}$ to gr. $\frac{1}{40}$.

Composition.—The important constituent is an alkaloid—*duboisine*—which possesses the medicinal powers and properties of the plant. It combines with acids to form salts which are freely soluble in water. As regards its chemical relations, duboisine strongly resembles atropine, but differs in some particulars; according to Ladenburg, duboisine is identical with hyoscyamine; but here again we have an illustration of the important fact that identity of composition does not necessarily imply identity of physiological action and therapeutical power. The dose of a salt of duboisine is $\frac{1}{100}$ to $\frac{1}{60}$ of a grain.

Antagonists and Incompatibles.—The caustic alkalies destroy the active principle, and consequently prescriptions containing them will be inert, except as to the effects of the alkali. The physiological antagonists are the same as those of atropine; thus physostigmine and muscarine counterbalance the action of duboisine in almost the entire range of power, and opium in a limited degree. Duboisine antagonizes pilocarpine, as respects, at least, the most conspicuous and important properties of the latter. In case of poisoning, emetics and the stomach-pump must be used, and the systemic effects opposed by the subcutaneous use of physostigma, muscarine, or morphine, cautiously, and certainly pilocarpine, further researches having proved the antagonism of the last named.

Synergists.—The actions of duboisia are promoted by the other agents of the group, especially by belladonna, stramonium, and hyoscyamus. The effects of atropine and duboisine correspond to a remarkable extent, but there are points of difference, as follows: Duboisine is twice or more soluble in water than atropine; it has stronger basic properties, and it reacts differently to sulphuric acid and bichromate of potassa; it is less irritating to the conjunctiva, dilates the pupil more promptly, and its effects subside earlier (Gerard).

PHYSIOLOGICAL EFFECTS.—Dryness of the mouth, thirst, and some difficulty in swallowing, soon follow the administration of duboisia, and more speedily after the subcutaneous injection of the alkaloid. The pulse is considerably accelerated; the arterial tension rises, the face flushes, the pupil dilates, and the accommodation is paralyzed. Some frontal headache, tinnitus aurium, giddiness, and restlessness, especially in sleep, are experienced. Certain motor symptoms—uncertain gait, awkwardness of movement in walking, and muscular paresis—occur (Gubler). In animals mental excitement or delirium has been noted, but no confirmatory or opposing observations on man have thus far been reported. The tetanic symptoms which occur after some days in frogs poisoned by atropine, take place under the same conditions from duboisia.

The acceleration of pulse and rise of tension first produced by duboisia do not persist; the pulse-rate and the tension fall after some hours, the excitement subsides, and a condition of stupor comes on which is not sleep, although it favors sleep (Gubler). I can confirm these important observations on the cerebral effects of duboisia.

THERAPY.—The author has prescribed duboisine in cases of *puerperal mania* with excitement, on the suggestion of M. Gubler, and with entire success. There is an increase of the maniacal excitement for a few hours after the hypodermatic injection, but this is followed by the condition of stupor and mental calm. The improvement is rapid, and follows so closely the administration of the remedy that he could not doubt it was *propter* and not merely *post hoc.*

As respects its use in ophthalmic diseases, it may be stated in general that duboisine is applicable under the same conditions as atropine, to which it is to be preferred, in many cases, it is probable.

The advantages of duboisine, as compared with atropine, are its greater rapidity of action in effecting *dilatation of the pupil* and *paralysis of accommodation*, the less irritation of the conjunctiva, and the more rapid recovery from the effects. It is, therefore, much more useful than atropine for determining the refraction of the eye, and for use in ocular therapeutics in general.

Some unpleasant cerebral effects have been observed after instillation into the eye (Seely). The author was given the opportunity, by the kindness of Dr. Seely, to examine the patient—the first instance in which such phenomena were observed—who experienced faintness and strange sensations in the head; but they were entirely subjective and mental, as no change in the circulation or respiration was to be seen. Since that case there have been several examples of the systemic action of duboisine after its instillation into the eye.

To relieve the *night-sweats* of phthisis and the various *neuroses of the respiratory organs*, and to *stimulate the action of the heart*, duboisine may take the place of atropine. As an antagonist to morphine it is equally as effective as atropine, but, as a hypnotic and anodyne, superior to the latter.

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Scopolamine.—An alkaloid obtained from the root of *Scopolia atropinoides*, a member of the *Solanaceæ*.

Scopolaminæ Hydrobromas.—Hydrobromate of scopolamine.

There is also a hydrochlorate, but as the hydrobromate is more easily obtained in a pure state this salt is now preferred.

The dose of the hydrobromate is $\frac{1}{200}$ grain to $\frac{1}{60}$ grain. The solutions employed by the ophthalmologists have ranged from 1 to 1,000, 1 to 2,000 as given by Raehlmann, and 1 to 1,000, 2 to 1,000, and 4 to 1,000 according to Gutmann.

ACTIONS AND USES.—Scopolamine was discovered by A. Schmidt, of Marburg. Raehlmann was the first to give an account of its actions, based on clinical investigations. G. Gutmann, of Berlin, and L. Grossmann, of Budapest, subsequently reported on its effects, also based on clinical experience in their respective clinics. As a member of the *Solanaceæ*, it was *a priori* supposed to possess mydriatic qualities, and the investigations of different observers confirm this view. In its actions and uses scopolamine corresponds closely to hyoscine and duboisine. In their clinical observations the ophthalmologists above mentioned compared the actions of the new remedy, especially with atropine. It was found that, as regards the eye symptoms, scopolamine acted more energetically and also more promptly in causing dilatation of the pupil than atropine. The effects are shorter in duration, so that several instillations a day are required to maintain a constant action.

It also affects the accommodative apparatus in a similar manner to atropine, but it has less influence on the intraocular tension. It is more efficient than atropine in inflammatory states of the eye, which is especially true of iritis; for dilating the pupil more decidedly, it breaks up adhesions more thoroughly. As respects dryness of the throat, dizziness, and hallucinations, which instillation of the mydriatics causes, these untoward symptoms are less common, and by no means so prominent, from the use of scopolamine. This agent acts in an opposed manner to atropine on the cerebral cortex ; instead of excitement, it induces a quiescent state of the mind and rather disposes to sleep. On the cardiac and respiratory functions it has effects different from atropine ; instead of increased action of the heart, and more frequent respiratory movements, it lessens both and tends to cause death by paralysis of respiration.

The testimony of ophthalmologists who have published their observations on scopolamine is strongly in favor of this remedy in most of the conditions for which atropine is now employed. As it acts so strongly on the pupil, and the time of the action is so brief, it is especially preferable for use in some morbid states of the eye, and for ascertaining errors of refraction. As it affects the intraocular tension little or not at all, it is not adapted to the treatment of cases in which the tension needs to be modified.

Scopolamine having properties not unlike hyoscine and duboisine, it would seem to be indicated in mental states characterized by excitement, wakefulness, and active delirium. It will prove valuable, it is probable, in cases of the insomnia of neurasthenia, in such spasmodic affections as chorea, in some examples of epilepsy and allied diseases.

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B.—AGENTS EXCITING THE FUNCTIONAL ACTIVITY OF THE CEREBRUM.

To this group belong those remedies usually classed together under the designation of *antispasmodics*. They are to a slight degree cardiac stimulants ; they increase the cutaneous circulation and promote diaphoresis ; they also stimulate the bronchial mucous membrane and favor expectoration. As a result in part of the increased rapidity of the circulation, the functions of the brain be-
ightly more active, ideas flow more freely, irregular mental
muscular hyperkinesis are moderated, and an orderly
g is experienced. These effects are probably in

part due to a direct action of these agents on the gray matter of the hemispheres, but our knowledge does not at present permit an exact statement of the nature of this impression. These agents do not in any quantity suspend the functions of the brain, and the temporary increase of activity which they produce is not followed by manifest depression.

Camphora.—Camphor. *Camphre*, Fr.; *Campher*, Ger. A stearopten derived from *Cinnamomum camphora* F. Nees et Ebermaier (Nat. Ord. *Lauraceæ*), and purified by sublimation.

Aqua Camphoræ.—Camphor-water. Dose, ʒ j—℥ j.

Linimentum Camphoræ. — Camphor-liniment. (Camphor, 200 grm.; cotton-seed oil, 800 grm.)

Linimentum Saponis.—Soap-liniment. (Soap, camphor, oil of rosemary, alcohol, and water.)

Spiritus Camphoræ.—Spirit of camphor. (Camphor, 100 grm.; alcohol to make 1,000 c. c.) Dose, ♏v—♏xx.

Camphora Monobromata.—Monobromated camphor. Dose, grs. ij—grs. x. Colorless, prismatic needles or scales, permanent in the air and unaffected by light, having a mild camphoraceous odor and taste, and a neutral reaction. Almost insoluble in water; freely soluble in alcohol, ether, chloroform, and fixed oils; slightly soluble in glycerin.

Composition and Properties.—Camphor is found in colorless, translucent, crystalline masses. One part dissolves in about 1,300 parts of water, but it is freely soluble in alcohol, ethers, oils, chloroform, bisulphide of carbon, etc. Its odor is peculiar and characteristic. The formula for camphor is the following: $C_{10}H_{16}O$. By distillation with chloride of zinc it is converted into *cymol*, and by oxidizing agents into *camphoric* and *camphretic* acids.

Antagonists and Incompatibles.—The addition of water precipitates camphor from its spirituous solution. Alkaline and earthy salts, for example sulphate of magnesium, separate from its solution the small quantity of camphor contained in aqua camphoræ. Coffee, the arterial sedatives, cold, and depressing causes generally, antagonize its physiological action.

Synergists.—All the remedies of this group, and alcohol, opium, and narcotic substances, increase the effects of camphor.

Physiological Actions.—Applied to the skin, camphor produces redness, heat, and superficial inflammation, if the contact be sufficiently prolonged; to an open wound its effects are still more severe. Its taste is hot, aromatic, and pungent. In the stomach it causes a sensation of heat, and may excite in large doses inflammation and ulceration. The symptoms common to irritant poisons may, therefore, be produced by camphor. After experimental doses in animals camphor has been detected in the blood of the mesenteric and portal vein, but not in the chyle or urine. In moderate doses (medicinal) it increases the action of the heart, elevates the arterial tension, and promotes cutaneous transpiration; it also produces mental exhilaration, even a gay and lively intoxication, and allays pain. In toxic doses, in addition to the local irritant action on the gastro-intestinal mucous membrane, and the consequent systemic effects, it lowers the pulse, the skin becomes pale, and the surface cold and moist, stupefies, diminishes the reflex functions of the spinal cord, and causes convulsions, insensibility, and death; but these cerebral phenomena are not separable from the reflex effects, on the nervous centers, of the violent gastro-intestinal disturbance. Sometimes dysuria has been caused by camphor, and, in small doses, owing doubtless to the merely stimulant effects on the circulation, it increases the sexual appetite; but, in large doses, it is antaphrodisiac.

Camphor, after absorption, is eliminated chiefly by the skin and bronchial mucous membrane, hence the breath and sweat of those using this substance smell of it strongly; but, when much camphor is taken in the solid form, it escapes with the fæces.

Therapy.—Camphor enters into the composition of many *dentifrices.*

Camphor is contraindicated in all inflammatory affections of the gastro-intestinal mucous membrane. In *hysterical vomiting* a few drops of the spirit (two to five), every half-hour or hour, will often give relief. Camphor is an efficient remedy in *summer diarrhœa.* It is usually combined with opium: ℞ Spirit. camphoræ, tinct. opii, āā ℥ ss. M. Sig.: *Ten to thirty drops every two, three, or four hours.* ℞ Aqua camphoræ, ℥ iij; tinct. lavendulæ comp., ℥ j; tinct. opii, ʒ j — ʒ ij. M. Sig.: *A tablespoonful every hour or two.* This is an excellent formula, omitting the opium, for *flatulence,* especially *hysterical flatulence* and the *flatulent colic* which so often occurs during the climacteric period. For the *preliminary diarrhœa* of *Asiatic cholera* camphor is largely used, and with very obvious benefit. A drop or two of the saturated tincture (Rubini's), or five to ten drops of the spirit, may be given with a little laudanum every half-hour or hour. Oppolzer gave the ethereal tincture with opium: ℞ Camphoræ, ℥ j; etheris, ℥ vij; tinct. opii, ℥ j. M. Sig.: *Twenty to forty drops, as necessary.* Camphor, which is very serviceable in the *summer diarrhœa of children,* may be given to these little subjects in milk, in which it is soluble in the proportion of one drachm to four ounces.

Spirits of camphor, in the form of vapor, is a useful inhalation in the incipiency of *acute catarrh.* Dr. Beard speaks in very enthusiastic terms of a camphor preparation which he has called "cold powder." This formula is as follows: "Camphor, five parts. Dissolve in ether to the consistence of cream. Then add carbonate of ammonium four parts, opium-powder one part." The dose of this ranges from three to ten grains. Dr. Beard finds this combination of "great value in *breaking up colds* when taken in time, and in modifying their force when taken late."

Camphor was formerly much used in the treatment of *asthma*, but at present more efficient remedies have taken its place. The monobromide of camphor has proved decidedly beneficial in *whooping-cough*. Five grains, suspended in mucilage and sirup of tolu, may be given to a child three or four times a day. It is most serviceable in the spasmodic stage, but will do good at any period.

Camphor will allay cough and promote expectoration, hence its utility in *chronic bronchitis*, in *capillary bronchitis* when stimulants are needed, and in *emphysema*. In the so-called *typhoid pneumonia* camphor is serviceable as a stimulant, in small and frequently-repeated doses, to sustain the powers of life during the period of defervescence.

In *typhus* and *typhoid fevers*, and in the *exanthemata* generally, camphor is used to accomplish two objects—to quiet delirium, subsultus, or restlessness, and to overcome the cardiac depression. When very active interference is unnecessary the following can be used: ℞ Aqua camphoræ, liq. ammoniæ acetatis, āā ℥ij. M. Sig.: *A tablespoonful every two hours.*

Attacks of *nervousness* and *hysteria* are relieved by camphor-julep, i. e., camphor rubbed up with mucilage. Some cases of *delirium tremens* are benefited by camphor, but it is impossible to indicate the special condition requiring it. *Maniacal excitement*, *melancholia*, and *erotomania*, have also been relieved by this agent, but a great uncertainty exists as to the indications for its employment. Large doses are necessary in these affections, and they should at first be tentative, for it is not possible in the present state of our knowledge to predict the results of any given trial. On the whole, but little dependence is to be placed on camphor; besides, more certain and effective remedies are now available for the treatment of these maladies.

There appears to be a satisfactory clinical experience as respects the use of camphor to *allay sexual excitement*. Large doses (from ten to twenty grains) diminish the venereal appetite and the vigor of the erections; hence the use of camphor in *priapism*, *satyriasis*, *nymphomania*, *chordee*, etc. The following is a formula of Ricord: ℞ Camphoræ, lactucarii, āā ʒj. M. Ft. pil. no. xxx. Sig.: *One or two pills, or more, as necessary.* For *nocturnal seminal losses*, with weakness and relaxation of the genitalia, the following formula is useful: ℞ Ergotæ ext. (Squibb), ℈ij; camphoræ, ʒj. M. Ft. pil. no. xxx. Sig.: *Two at bed-hour.* A full dose of camphor will often arrest the *strangury* produced by blisters.

Considerable testimony has been collected showing the value of camphor as a remedy in *senile gangrene*, and in *hospital gangrene*. Five to fifteen grains every four hours may be given in an emulsion, and powdered camphor may be applied freely to the sloughing surface. A clyster of camphor is an effective remedy against *ascarides*.

Camphor was a favorite remedy with Dewees for *dysmenorrhœa*. He gave ten grains in a mixture with mucilage and cinnamon-water, and repeated the dose in an hour or two if necessary. For *after-pains*, camphor (ten grains), in a mixture with a little morphine (one eighth of a grain), is an effective remedy.

External Uses.—A cataplasm of camphor, morphine, and flaxseed, applied to the cheek, will relieve *toothache*. *Camphorated oil* is a mild counter-irritant, which is a useful external application for the relief of internal inflammations. The solution of camphor in ether has been applied locally with benefit in *erysipelas*. *Myalgia*, *lumbago*, and *neuralgia of superficial nerves*, may sometimes be relieved by frictions with camphorated oil or soap-liniment. Powdered camphor, freely sprinkled over the surface, is one of the means resorted to, and sometimes with success, to prevent *pitting of the face from variola*.

Camphor and chloral triturated together form a clear liquid, which will take up morphine, atropine, and other alkaloids, in large quantity. The solution containing the alkaloids can be mixed with chloroform without precipitation. This constitutes a topical application of great power, which can be utilized in the treatment of pain and inflammation, painted over the part affected by a camel's-hair brush, or by means of absorbent cotton saturated, covered with oilsilk, and kept in position as long as it can be borne. This solution may be given internally also, but, as it is irritating, only in small doses, and after meals.

The formula used by the author is: Equal parts of camphor and chloral; after it is liquefied by trituration, morphine and atropine are added, and then some pure chloroform mixed in drop by drop. Thus: ℞ Camphoræ, chloral, āā ℥ ss. Mix, and add morphinæ sulph., ℈j; atropinæ sulph., gr. v. When dissolved, add slowly, chloroformi, ʒ ss.

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Acidum Camphoricum.—Camphoric acid. [Not official.] By the oxidation of camphor with nitric acid camphoric acid is produced. As it occurs in commerce it is crystalline in structure, whitish in color, slightly acid to the taste and in reaction, and it is without odor. It is nearly insoluble in cold water, freely soluble in hot water, and it dissolves in alcohol, ether, oils, etc. The best menstruum is vaseline oil, and this is the most suitable vehicle for hypodermatic injection.

The dose of camphoric acid ranges from 5 to 20 grains. It is best administered in wafer or capsule, but may also be prescribed in some alcoholic tincture, or in vaseline. If large doses are to be given, not more than two should be ordered in twenty-four hours.

ACTIONS AND USES.—In small medicinal doses (2 to 5 grains) camphoric acid stimulates digestion, improves the appetite, and hastens peristalsis. In large doses (20 grains) it causes a sense of heat, and eructations are apt to occur. In massive (toxic) doses it sets up gastro-intestinal inflammation, with the local and systemic states that belong thereto. It is a very diffusible substance, entering the blood and diffusing out again into the urine quickly, about five hours being occupied in the process (Bohland).

Camphoric acid has considerable antiseptic power; it destroys the germs of putrefaction, and is actively toxic against pathogenic organisms. It is said to render inactive the bacillus tuberculosis, and when administered as an antiseptic in tuberculosis of the intestines it was found to be effective in arresting the sweats of consumption. In catarrh of the bladder and putrefaction of the urine it has proved to exert a decided antiseptic influence.

The most important uses of camphoric acid are in the treatment of the gastro-intestinal troubles of phthisis—*tuberculous diarrhœa*—to arrest the *sweats of phthisis*, and as an antiseptic and topical remedy in *catarrhal states* of the genito-urinary apparatus. In the treatment of gastro-intestinal affections medium doses (about 10 grains) should be given three times a day, an hour or two after meals. To arrest the sweats of phthisis, a single full dose (20 grains) should be given at bedtime. As it is excreted in five hours after it is administered, should the sweats occur toward morning a second dose may be necessary after midnight. When used to act on the genito-urinary mucous membrane, small doses (5 grains) frequently repeated should be given. Of the quantity taken almost all appears in the urine.

Asafœtida.—Asafœtida. A gum-resin obtained from the root of *Ferula narthex* Boissier, and of *Ferula fœtida* (Bunge) Regel (Nat. Ord. *Umbelliferæ*). *Asafœtida*, Fr.; *Teufelsdreck*, Ger.

Emulsum Asafœtidæ.—Asafœtida-mixture. (Asafœtida, 40 grm. to 1,000 c. c. of water.) Dose, ℥ ss. — ℥ ij.

Tinctura Asafœtidæ.—Tincture of asafœtida. (Asafœtida, 200 grm., and alcohol sufficient to make 100 c. c.) Dose, ʒ ss. — ʒ ij.

Pillulæ Asafœtidæ.—Pills of asafœtida. (Asafœtida and soap.) Each pill contains about three grains of asafœtida. Dose, 1—4 pills.

Pilulæ Aloës et Asafœtidæ.—Pills of aloes and asafœtida. (Asafœtida, aloes, soap.) Does, 1—4 pills.

Pilulæ Galbani Compositæ.—Compound pills of galbanum. (Asafœtida, galbanum, and myrrh.) Dose, 1—4 pills.

Composition.—About one half of the gross constituents of asafœtida consists of *resin*. This is not wholly soluble in chloroform or ether. It contains a peculiar acid (*ferulaic acid*). Asafœtida also contains a sulphureted and phosphureted *volatile oil*, in the proportion of from three to five per cent. This oil is at first neutral, but becomes acid by exposure to the air, and evolves sulphureted hydrogen. It possesses in a high degree the disagreeable odor of the drug.

Asafœtida also contains *malic acid*, and acetic, formic, and valerianic acids are products of the watery distillation. There is sufficient gum present also to form an emulsion with water.

Antagonists and Incompatibles.—Acids, neutral salts, cold, and arterial sedatives, oppose the action of asafœtida.

Synergists.—The gum-resins, the balsams, and the aromatics, essential oils containing sulphur and phosphorus, and alcohol and ether, promote the physiological and therapeutical activity of asafœtida.

Physiological Actions.—Asafœtida possesses an extremely characteristic odor, and a pungent, rather hot, and faintly acrid taste. It excites by its presence in the fauces an increased flow of saliva. It stimulates secretion from the gastro-intestinal mucous membrane, promotes the appetite, improves digestion, and increases peristalsis. The fæces are somewhat softer, and are very offensive from the presence in them of sulphur and phosphorus compounds, resulting from the decomposition of the essential oil. In large quantity asafœtida causes nausea, vomiting, and purging. The active principle (the essential oil) undoubtedly slowly diffuses into the blood, for the odor of it is detectable in the sweat and breath. Increased action of the heart, a higher temperature of the surface (subjectively, at least), more or less diaphoresis, and diuresis, have been observed to follow its medicinal administration. It acts as a gentle stimulant to the brain, induces a feeling of well-being, increases the flow of ideas, and causes, as the author has observed in one case, certainly, sufficient exhilaration of a pleasant kind to be regarded as an intoxicant.

Asafœtida is eliminated by the skin, intestinal and bronchial mucous membrane, and in small part by the kidneys. The functions of all these organs are increased in activity by the local stimulant effect. Partly due to the general rise of arterial pressure which it produces, partly to its local action in the process of elimination, and partly to its phosphorus compounds, asafœtida increases the menstrual flux, and, in both sexes, the venereal appetite.

Therapy.—Asafœtida is used in the country of its habitat as a *condiment*. A little—very little—rubbed on the gridiron, improves the flavor of beefsteak. If it were not for its intolerable odor, and for the horrible eructations which follow its use, even when disguised in a sugar-coated pill, it would be much employed as a *stomachic tonic* in *atonic dyspepsia*, accompanied by torpor of the intestines. For the *flatulent colic of infants* no remedy is better than *mistura asafœtidæ*, which may be given in teaspoonful doses. It is especially in the *flatulence of hysteria and hypochondriasis* that this remedy is serviceable. It expels the flatus, promotes intestinal secretion and digestion, and relaxes the bowels. In this way the mind is relieved, for the action of asafœtida extends beyond this improvement in the state of the chylopoiëtic viscera—it induces a condition of mental cheerfulness which takes the place of the abnormal mobility of *hysteria*, and of the gloom of *hypochondriasis*.

The official pill of aloes and asafœtida is an excellent combination for the relief of *constipation*, when associated with *amenorrhœa*. It is adapted, of course, to those cases in which there is a condition of anæmia rather than of plethora, and in which there exists a state of torpor of the ovaries, as well as of the intestinal canal. These conditions existing, the combined pill of aloes and asafœtida is indicated whether hysteria be present or not.

The *chronic scaly eruptions*, *chronic eczema*, etc., especially when the skin is dry and harsh, are much improved by the persistent use of asafœtida.

Bronchorrhœa, *bronchitis* after the acute symptoms have subsided, the *cough maintained by habit* which may succeed the whooping-cough, and the *sympathetic cough of mothers* whose children are experiencing whooping-cough, are greatly benefited by asafœtida. ℞ Mist. asafœtidæ, ℥ iv ; ammonii muriat., ʒ j. M. Sig.: *A tablespoonful as necessary.*

Asafœtida, which was formerly much prescribed in *asthma*, *whooping-cough*, and other neuroses of the respiratory organs, has been supplanted by more efficient remedies.

The disagreeable odor of asafœtida, which is a bar to its employment in many of the diseases to the treatment of which it is very well suited, is not an objection to its use in *hysteria*, *hypochondriasis*, and *epilepsy*. The moral effect of its repulsive odor is not without influence in the psychic realm. But the effect of asafœtida is not simply on the imagination of the patient; it has constituents of very positive quality, which impress the brain. Hence the utility of asafœtida to arrest the *hysterical paroxysm*, and to relieve the numerous maladies in which the hysterical constitution disports itself. The remarks already made in regard to the action of asafœtida on the digestive functions in hypochondriacal subjects, render it unnecessary to speak more at length on the use of this remedy in *hypochondriasis*. Asafœtida is no longer employed in the treatment of *epilepsy*, except in the so-called *hystero-*

epilepsy. The *convulsions of childhood*, from reflex irritation, are sometimes relieved by this remedy, but it is entirely without utility in convulsions arising from renal or cerebral disease.

Ammoniacum.—Ammoniac. A gum-resin obtained from *Dorema ammoniacum* Don (Nat. Ord. *Umbelliferæ*). *Gomme ammoniaque*, Fr.; *Ammoniakgummi*, Ger.

Emplastrum Ammoniaci.—Ammoniac-plaster.

Emplastrum Ammoniaci cum Hydrargyro.—(Ammoniac, mercury, diluted acetic acid, and lead-plaster.)

Emulsum Ammoniaci.—Ammoniac-mixture. (The resin is suspended by the gum in water.) Dose, ℥ ss— ℥ j.

COMPOSITION.—Ammoniac contains a volatile oil, which differs from the asafœtida oil in not containing sulphur. It has the odor of the drug. Ammoniac also contains gum and resin, the latter in the proportion of about seventy per cent.

ANTAGONISTS, INCOMPATIBLES, and SYNERGISTS, same as for asafœtida.

PHYSIOLOGICAL ACTIONS.—The effects of ammoniac are similar to those of asafœtida, but it is much less active, owing to the fact, chiefly, that its volatile oil does not contain sulphur and phosphorus compounds.

THERAPY.—Ammoniac may be used for the same purposes as asafœtida, but it is much less efficient than the latter. At present its use is almost entirely restricted to *chronic bronchial affections*, in which the *mistura* is prescribed usually with the carbonate or chloride of ammonium. Ammoniac-plaster is sometimes used as a discutient to indolent glandular and inflammatory swellings.

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Valeriana.—Valerian. The rhizoma and rootlets of *Valeriana officinalis* Linné (Nat. Ord. *Valerianaceæ*). *Valériane*, Fr.; *Baldrianwurzel*, Ger.

Extractum Valerianæ Fluidum.—Fluid extract of valerian. Dose, ʒ ss— ℥ ss.

Tinctura Valerianæ.—Tincture of valerian (200 grm. to 1,000 c. c.). Dose, ʒ ss— ʒ ij.

Tinctura Valerianæ Ammoniata.—Ammoniated tincture of valerian (200 grm. of valerian and aromatic spirit of ammonia to make 1,000 c. c.).

Ammonii Valerianas.—Valerianate of ammonia. Is a white salt, in the form of quadrangular plates, having the disagreeable odor of valerianic acid, and a sharp, sweetish taste. It deliquesces in a moist air, but effloresces in a dry one, and is very soluble in water and in alcohol. It is decomposed by potassa, with evolution of ammonia, and by the mineral acids with separation of valerianic acid, which rises to the surface in the form of oil.

Oleum Valerianæ.—Oil of valerian. Dose, ♏ ij—♏ iv.

COMPOSITION.—Valerian contains from one to two per cent of an *essential oil*, which, if distilled from the perfectly fresh plant, has but little odor. In the process of drying of the root, or on exposure to the air of the oil distilled from fresh roots, *valerianic acid* is formed. As obtained from the dried root, the oil of valerian consists of *valerianic acid*, a *camphor*, *valerene*, and *valerol*.

An acid strongly resembling valerianic is obtained by the oxidation of amylic alcohol; but the two acids are not identical. The valerianic acid of pharmacy is, however, obtained in this way, and the various valerianates are products of the combination of the acid formed from amylic alcohol with bases.

ANTAGONISTS AND INCOMPATIBLES.—Quinine, digitalis, ergot, and remedies acting similarly, antagonize the actions of valerian.

SYNERGISTS.—All the agents of this group, opium, alcohol, ether, etc., increase the action of valerian.

PHYSIOLOGICAL ACTIONS.—Valerian and its preparations have a hot, pungent taste, and a peculiar and disagreeable odor. A sensation of warmth at the epigastrium follows when it is taken into the stomach. In large doses, nausea, hiccough, eructations of the drug, vomiting, and diarrhœa, may be produced. In small doses no appreciable physiological effects are observed; but in considerable doses the action of the heart is increased, the temperature of the surface rises, and diaphoresis occurs. As respects the nervous system, headache, vertigo, exhilaration of mind, spectral illusions, hallucinations, have, it is said, been produced by valerian; but these results are by no means constant phenomena. According to Von Grisar (Köhler), oil of valerian reduces the reflex excitability, motility, and sensibility, and antagonizes the tetanizing action of brucine.

The odorous principle—valerianic acid—appears in the sweat, breath, and also the urine.

THERAPY.—*The flatulence of the hysterical and hypochondriacal* is quickly relieved by the tincture or fluid extract of valerian.

It sometimes happens that a mild attack of *spasmodic asthma* may be relieved by valerian, but this by no means efficient remedy quickly loses its effect. *Whooping-cough*, *laryngismus stridulus*, and other *neuroses of the respiratory organs*, may be occasionally modified by this agent; but it is by no means equal to many other remedies now available.

The chief therapeutic use of valerian is in the treatment of *nervousness, hysteria*, and *hysterical disorders generally*. There can be no difference of opinion as to its great value in these cases; but as respects *epilepsy, chorea, paralysis agitans*, etc., in which it was formerly used, it must suffice to say that it is now never prescribed.

Under the impression that the physiological and therapeutical activity of valerian depends on valerianic acid, various valerianates have been introduced into practice. The only one which requires notice here is the *valerianate of ammonia*, which in the form of elixir is frequently prescribed in hysterical affections. Fluid extract of valerian has been used with advantage in *diabetes insipidus* and also in *saccharine diabetes*, but the results are not permanent. It diminishes the amount of urinary water in both, and lessens the excretion of sugar in the latter, but these effects continue only while the remedy is given.

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Cannabis Indica.—Indian cannabis. The flowering tops of the female plant of *Cannabis sativa* Linné (Nat. Ord. *Urticaceæ, Cannabineæ*), grown in the East Indies. *Chanvre Indien*, Fr.; *Hanfkraut*, Ger.

Preparations.—*Extractum Cannabis Indicæ.*—Extract of cannabis Indica. Dose, gr. ¼—gr. ij or more.

Extractum Cannabis Indicæ Fluidum.—Fluid extract of cannabis Indica. Dose, ♏ ij—ʒ ss.

Tinctura Cannabis Indicæ.—Tincture of cannabis Indica. Dose, ♏ v—ʒ j.

Cannabinum Tannicum.—Dose, gr. j—gr. x.

Composition.—The most important constituent of hemp is a peculiar *resin, cannabin*, which possesses the active powers of the plant. By distillation of the leaves and stems, a peculiar *volatile oil* is obtained; and this is divisible into *cannabene*, a very light hydrocarbon, and *hydride of cannabene*, a solid crystalline substance.

An impure resin, collected in an imperfect and crude way from the leaves and stems, is known as *charas* or *churrus*. *Bhang* consists of the dried leaves and stalks made into a confection with preserved fruits and aromatics, and in this form constitutes the well-known *hashish*. *Gunjah* is the female flowering plant, dried, from which the resin has not been extracted. There are important differences of opinion as to the active constituents. According to Roux, the new preparation—

the tannate of cannabin—has no obvious effects, is in fact inert. The volatile oil, which Personne thinks is the true active principle, has also been shown to have no special power. The alcoholic extract is inert, and Duquesnel's proved to be no more active. The resin, it seems to be demonstrated, is the active part, or contains it. The petroleum (rhigolene or benzine ?) extract has excitant and convulsive property, and is distinctly toxic.

No arbitrary rules for the dose can be laid down. In beginning the use of any newly-made preparation, it is safer to commence with the minimum dose. Having, by gradually increasing the quantity, ascertained the physiological activity of that particular specimen, it may then be pushed according to the necessities of the case.

Antagonists and Incompatibles.—The caustic alkalies, the acids, strychnine, and induction electricity, oppose the actions of hemp. In cases of poisoning, the stomach should be evacuated, and symptoms be combated as they arise. Strychnine may be injected hypodermically, and the respiration be maintained by faradization of the respiratory muscles. As, however, hemp possesses but feeble toxic power, cases of acute poisoning have never been reported.

Synergists.—Alcohol, ether, nitrous oxide, the mydriatics—belladonna, hyoscyamus, etc.—opium, and the cerebral stimulants generally, promote the actions of hemp.

Physiological Actions.—The resin of hemp is a soft solid; is soluble in alcohol and in ether, in the fixed and volatile oils, and in the fats. It has a balsamic taste, but is bitter and acrid. It promotes the appetite and the digestion somewhat. The most important actions are those referable to the nervous system. There is a distinction to be made between the effects on the nervous system of the inhalation of the fumes of hashish and those effects which follow the stomach administration. Inattention to this point has, probably, given rise to most of the confusion regarding the physiological actions of this remedy. When inhaled it produces a singular muscular erythism and agitation, a great desire for muscular activity and motion, an entire absence of the sense of fatigue; but these sensations are followed by exhaustion, even by syncope. Hallucinations occur, but they are not usually agreeable; they are often painful, and are replaced by stupor.

By the stomach, and in moderate doses, hashish is an excitant of the nervous system, increasing intellectual and motor activity. In large doses, it lowers the tactile sense and the sense of pain—in other words, it is analgesic and anæsthetic—and it induces a cataleptic state, in which the muscles maintain any position in which they may be placed. The mental intoxication is ordinarily of an agreeable kind; the ideas flow more easily, are highly pleasurable, and are usually accompanied by bursts of gay laughter. Not unfrequently the excitement takes the form of a furious delirium, in which acts of violence are committed—whence the name "haschaschins," or assassins, applied to the unfortunate hashish-eater who, under the influence of the drug, commits murder. It has been maintained, and probably rightly enough, that the form which the delirium takes represents the mental and moral condition of the individual in his normal state: those who are amiable and gay become more so under the influence of hashish; and those possessed of evil and malignant dispositions enact deeds of violence.

Under the influence of hashish the knowledge of time is lost; such are the number and variety of the images which occupy the mind, that a few minutes appear to be hours, days, or even years. After the effects of the drug have passed off, the hashish-eater is usually unconscious of the events that have transpired. Sleep or coma, according to the dose, ends the effects of the drug.

Dilatation of the pupil, and disorders of vision, which contribute to the hallucinations by the distortion of external objects, are produced by hemp. Aphrodisiac effects are said to follow the use of hashish; but impotence, which is common in hashish-eaters, doubtless results from the repeated over-stimulation of the sexual organs.

It is not known by what organs, or in what form, hashish is eliminated. The effects of a large dose are not entirely expended in twenty-four hours, and those who have taken it by way of experiment have suffered vertigo, headache, and other cerebral symptoms, for some time subsequently. It does not increase any of the secretions, except it may be the urinary, somewhat; and it does not stimulate into increased activity any organs except the cerebro-spinal and the sexual. The sleep or stupor which it produces, and which comes on after the stage of excitement, is not followed by after nausea and depression, as in the case of opium.

THERAPY.—The extract of cannabis Indica enters into the composition of chlorodyne, a nostrum which has had a great reputation as an anodyne and hypnotic. In *cholera morbus* and *diarrhœa* this remedy has been used successfully, but we now possess more efficient ones.

Before the days of anæsthesia, and in very remote times, the fumes of hashish were employed to stupefy and to render painless surgical operations. It was also employed to relieve *pain*, and as a substitute for opium in *neuralgia*, and as an *hypnotic*. In *migraine* it has been used with decided success by Seguin, Williams, and others. Good results have been obtained from it in *epilepsy* by Sinkler and others, and it deserves further consideration in this disease. In *chorea*, and in *delirium tremens*, it is strongly urged by De Cavaillon, and in *senile trembling* and *paralysis agitans* it has afforded relief. About one half of the cases of *tetanus*, for which hemp was much prescribed a few years ago, got well under its use; but more accurate knowledge of the natural history of this disease has shown that many cases tend to recovery without the aid of medicines.

It is well established that hemp has the power to promote uterine contractions. It can not initiate them, but increases their energy when action has begun. It may be given with ergot. In consequence of this power which it possesses to affect the muscular tissue of organic life, hemp is used successfully in the treatment of *menorrhagia*. It is said to be especially useful in that form of *menorrhagia* which occurs at the climacteric period (Churchill). It has, more recently, been shown to possess the power to arrest *hæmorrhage* from any point, but it is chiefly in menorrhagia that much good is accomplished.

There can be no doubt that cannabis Indica is a useful remedy in cases of *impotence*. It need hardly be stated that it is adapted to the functional disorder. It may be advantageously combined with ergot and nux vomica in this malady; for example: ℞ Ext. cannabis Indicæ, gr. x; ergotin (aq. ex.), ℈ij; ext. nucis vom., gr. x. M., ft. pil. no. xx. Sig.: *One morning and evening.*

This agent has also been used with success in the treatment of *gonorrhœa*. It diminishes the local inflammation, allays chordee, and lessens the pain and irritation, with the accompanying restlessness.

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Flückiger and Hanbury. *Pharmacographia*, p. 491.
Seguin, Dr. E. C. *New York Medical Record*, vol. xii, p. 774.
Williams, Dr. S. W. *London Medical Record*, vol. i, p. 407.

Coca.—Coca. The leaves of *Erythroxylon coca* Lamarck (Nat. Ord. *Lineæ*).

Preparation.—*Extractum Cocæ Fluidum.*—Fluid extract of coca. Dose, ʒ ss—ʒ ij.

Composition.—The effects of coca depend on the presence of a peculiar alkaloid—*cocaine*. It contains also an aromatic oil which gives it the special aroma and taste, and it possesses considerable astringency, due to the presence of a tannic acid. The odor, taste, and appearance of the infusion are comparable to those of tea. Cocaine has decided basic properties, and combines with acids to form salts. It crystallizes in prisms in the smaller rhombic system (Husemann), which, when pure, are transparent and colorless. It is very slightly soluble in water and in alcohol, but dissolves freely in ether. It has a bitter taste, and the salts are more bitter than the alkaloid itself.

Cocainæ Hydrochloras.—Cocaine hydrochlorate. Colorless, transparent crystals, or a white crystalline powder, without odor, slightly bitter taste, and producing on the tongue a tingling sensation, followed by numbness of some minutes' duration. Soluble at 59° Fahr. (15° C.) in 0·48 part of water and in 3·5 parts of alcohol.

Tropacocaine (benzoylpseudotropein) is an alkaloid of the smallleaved coca of Java. This was first extracted from the plant by Giesel, and it was made synthetically by Liebermann, who proved its identity with pseudotropein of hyoscyamus.

Physiological Actions.—The historical notes of Sir R. Christison show that the peculiar properties of cuca-leaves have long been known to the inhabitants of Peru. The leaves have a strong, tea-like odor, and the infusion resembles ordinary tea in taste. The volatile oil and the active principle are readily diffusible, and enter the blood with facility. A momentary depression of the pulse and diminution of the blood-pressure take place, but these effects are quickly overcome, and a considerable increase in the action of the heart and of the blood-pressure follows (Ott). A feeling of contentment and of well-being takes possession of the mind, the sense of fatigue is removed, drowsiness is experienced for a brief period, but it is soon succeeded by wakefulness and increased mental activity. It has long been known to the mountaineers of the Peruvian Andes that chewing cuca-leaves increases the respiratory power, and removes, or lessens, the sense of fatigue. The celebrated pedestrian, Weston, having learned this fact, was detected in the use of cuca during one of his extraordinary feats in London (Thompson).

Although erythroxylon (coca or cuca) had been the subject of investigation and its power to suspend the functions of the sensory nervous system recognized, the character of its local action was not suspected. It was reserved for Dr. Koller, of Vienna, to discover its analgesic effects when applied directly to the mucous membrane, and this great fact he demonstrated before the Ophthalmological Congress at Heidelberg. It happened that the distinguished ophthalmologist of New York, Prof. Dr. Noyes, was in attendance on the Congress, and he sent to the New York "Medical Record" a letter giving the facts of the discovery, and this proved to be the first statement in the English language of Koller's demonstration. As the possibilities of the future utility of cocaine as a local anæsthetic was then recognized, it created a profound impression, and in an incredibly short time this remarkable discovery became the common interest and the common possession. Everywhere cocaine was investigated by physiological and clinical methods, and the results confirmed the statements of Koller. By no one on this side of the ocean was the investigation of the properties and powers of cocaine, more especially from the standpoint of the ophthalmologist, more carefully conducted than by Knapp, of New York, who confirmed the results attained by Koller. Before the Congress of Ophthalmologists Koller exhibited the effect of a four-per-cent solution applied to the conjunctiva—such a degree of anæsthesia being induced by it that this delicate membrane bore cutting, pinching, and tearing without any manifestation of pain and without exciting reflex action. It was also shown that the local action of cocaine included a condition of anæmia of the parts due to an active contraction of the arterioles. Only the mucous membrane is rendered anæsthetic. The skin is not penetrated unless an abrasion or some punctures permit the solution to pass through.

It was early observed that idiosyncrasy influences greatly the effects of cocaine. A few drops instilled into the eye and through the vessels of the nares entering the circulation have caused sudden and severe depression of the vital powers, great weakness of the heart's action, slow and shallow respiration, and convulsive jerkings of the muscles. Similar and more severe symptoms have accompanied the hypodermatic injection of a small dose (an eighth of a grain), and death has ensued suddenly from heart-failure in not a few instances when moderate doses have been administered in this way.

The character of the action of cocaine is much influenced also by the amount administered, and the several stages of its action differ because the immediate and primary effect is necessarily opposed to the condition of reaction which seeks to restore the normal. When a sufficiently active dose is given, the first effect is stimulation ; the heart-beats are accelerated ; the respiration becomes more frequent ; the reflexes respond to a distant irritation more promptly ; the mind experiences a grateful sense of well-being and of activity, and ideation is ready, acute, and comprehensive.

The stage of excitement continues for an hour or two, and is succeeded by depression, which is at the same time physical, mental, and moral. The pulse may continue quick, but its force declines, and some irregularity of the rhythm may occur ; the skin grows moist or profuse sweating comes on ; the body temperature declines a little, possibly ; the appetite is lost, and nausea and vomiting increase the feelings of physical wretchedness and moral distress. These are the conditions which impair nutrition. Observations made on those unfortunates addicted to the use of morphine and cocaine have proved misleading. The decline in the weight of the body is for the most part due to the gastro-intestinal derangement and to the complete anorexia which is a result of the withdrawal of the morphine. No doubt cocaine contributes to the wasting to some extent. Although cocaine is not actively toxic, and may be taken in enormous doses, some persons are highly susceptible to its action, and are profoundly depressed by a minute quantity. On the one hand, we find that Dr. Hammond, who reports taking eighteen grains at a single dose, has experienced only disturbed sleep and severe headache as a consequence ; on the other hand, a susceptible woman, who is made faint, nauseated, and seriously depressed by the minute quantity that has passed into the nares from an instillation into the eye.

In the smaller medicinal doses ($\frac{1}{8}$ to $\frac{1}{4}$ grain) cocaine stimulates the nerve-functions, gives clearness and power to the tones of the voice, heightens the reflexes, and raises the arterial tension. Large doses act briefly in the stimulating way above described, but the depression stage quickly succeeds, then the mental activity declines, memory is impaired, and a sense of weariness comes on. During this period there is more or less sweating, sometimes profuse, and a tingling and pricking sensation accompany it.

Cocaine pursues a certain order in its action on the brain and nervous system : first the hemispheres, then the lower motor and co-ordinating centers and the reflex centers, including respiration and also the vaso-motor center. The sensory paralysis includes the posterior columns ; but it is held by the principal authorities that it begins in the peripheral nerves, and thence extends to the sensory tract in the spinal cord. Cocaine has a distinctly convulsant action in animals, as has been experimentally shown by many observers. These convulsions are clonic in character. Similar results occur in man from large doses, and have been especially observed in the subjects of its habitual use, when suddenly acted on by massive doses. The convulsive movements are accompanied by irregular action of the heart, by sighing and shallow respiration, and by hallucinations of vision and hearing.

Cocaine first stimulates and afterward paralyzes the pneumogastric nerve, and the respiration is first increased and afterward paralyzed, failure of respiration being the mode of dying.

The utility of cocaine was first demonstrated in ophthalmological practice. The manner of its action on the eye has been carefully worked out as a basis for its therapeutical applications. When instilled into the eye, anæsthesia is first induced in the conjunctiva and cornea, and this effect may be accomplished by a solution having the strength of 2 to 100 ; but stronger solutions (5 to 100) act more quickly and efficiently. When the deeper parts of the eye are to be acted on, the stronger solutions are made use of, and the contact must be sufficiently prolonged. Wounds of the eyes and incisions made are utilized to secure the diffusion of the anæsthetic to the deeper parts of the organ. A simple congestion of the conjunctiva does not hinder the effects of cocaine ; but chronic changes in the structures of the organ have a retarding influence. Some dilatation of the pupil begins in about fifteen minutes after an instillation, but the pupil remains sensitive to light (Koller). Accommodation is somewhat affected, but not sufficiently so to be an interference. The mydriasis reaches its maximum in about an hour, and subsides in three or four hours afterward.

Cocaine is eliminated by the kidneys and may be detected in the urine. The excretion takes place in a short time, in a few hours.

Therapy.—The preparations of coca, especially the wine, are much employed as stomachic tonics. The consumption of wine of coca (a solution of cocaine in wine) must be enormous, for numerous preparations are on the market. They are advertised in the most lavish manner, and so freely dispensed to physicians in the form of trial specimens that only large sales with immense profits can justify the expenditure. The author has observed that clergymen, and men with scruples and high moral character, take this wine freely, and not without a devout appreciation of its grateful action in time of need.

To illustrate : a clergyman of character, attainments, and rhetorical skill, informed me that he always took a *small* wine-glassful of the wine of coca before his Sunday morning service. He had found that it banished fatigue, gave a resonant tone to his voice, and freed his intellect from the trammels of a written discourse, and gave scope and power to his sermon. Those who at first experienced this grateful addition to their resources came after a time to that melancholy stage of its action when the dose taken must be larger, and consequently an increasing depression with its baleful associations continually succeeds to the shortening stage of agreeable excitation.

In various neuroses of the respiratory organs, *asthma*, *whooping-cough*, *singultus*, etc., there can be no doubt respecting its curative power, and small doses are more useful than large ones in these cases. The effects are more decided when the remedy is thrown under the skin, and a single dose may give more relief than weeks of other treatment. In the case of neurotic individuals with the irritable and impressionable nervous system characteristic of the type, cocaine, more especially when administered hypodermatically, has acted in a way to indicate serious danger. We have already pointed out how it is that such an idiosyncrasy may endanger, even take, life by sudden failure of respiration or of circulation.

The topical action of cocaine in *hay-fever* has proved to be a valuable expedient. The solution, *four* to *ten per cent*, in spray or applied by the brush to the whole surface of the nasal and faucial mucous membrane, lessens congestion and secretion, and prevents the passage to the respiratory center of the peripheral irritation. Better than with a solution the parts affected are easily acted on by the slow solution of a compressed pellet placed conveniently in the anterior nares behind the cartilages. Numerous reports have been made of the complete relief afforded by this mode of application.

Most remarkable have been the successes obtained by the local applications of cocaine to abate *inflammation*, to stop or to *relieve pain*. It must not be forgotten that swallowing during and immediately after local applications to the nares and fauces may cause systemic effects. Cases have occurred in which a small quantity thus entering the system has brought on the most alarming syncope. The small quantity escaping by the tear-duct into the nose, thence into the œsophagus, has also in a few instances caused faintness.

action and paralyzing effect on the accommodative apparatus more atropine. In the rapidity of the action on the pupil, in the degree of dilatation, and in the persistency of the mydriatic effects, it has more the action of atropine, but is more powerful and also more enduring.

Injected subcutaneously, very soon convulsions of a tetanic character are produced; trembling precedes the tonic spasms, and occurs also between them, while paresis, quickly passing into paralysis, results from the exhaustion of over-stimulation. In respect to the behavior of the tetanic convulsions, they more resemble those of picrotoxin than of strychnine.

When the mixture was first brought forward it was asserted that it affected cutaneous sensibility in the same way that it does that of the mucous membranes. Knapp was unable to verify this observation, and such a claim has not been made since.

The therapeutical applications of the combination can be deduced from the physiological actions. Thus far the course of the investigations has been limited to the uses of the new mixture in ophthalmic practice; but indications are thus furnished to guide its applications in diseases in general.

The conclusions of Knapp, based on Dr. Claiborne's and his own observations, are as follows:

In cases of iritis, the combination of cocaine and atropine is superior to cocaine alone, and should also be preferred to atropine alone when pain is suffered, and when a tendency to glaucoma exists. On the other hand, when the mydriasis is an objection—as in the case of most of the operations on the eye—cocaine should be preferred. When paralysis of the accommodative apparatus is desirable, the compound acts as efficiently as atropine, and is preferable, because its effect is shorter in duration.

Small doses, rapidly absorbed, may cause, as does cocaine, some general disturbance, which consists in sudden pallor, cold sweats, vertigo, stupor, faintness, etc., and large doses, approaching lethal in strength, bring on tetanic spasms, trembling, rapid action of the heart, and failure of respiration.

Inducing complete anæsthesia of the mucous membrane at any point, surgical procedures of all kinds may be carried on without any sensation of uneasiness. In all the morbid states in which cocaine has hitherto been used alone, the combination may be substituted, unless the dilatation of the pupil constitute an objection.

With Chloral and Urethan.—It has long been known that chloral has the power to liquefy various agents, as camphor, urethan, and others. The combination of chloral and urethan being effected, cocaine will dissolve in it to any desirable extent. Thus: ℞ Chloral.

Cocaine is a remedy of the highest value in *chorea.* The author has repeatedly cured cases in which all the ordinary and some extraordinary remedies had been used in vain. The whole amount given daily has rarely exceeded one half a grain. *Paralysis agitans,* alcoholic *tremors,* and *senile trembling,* are more favorably affected by cocaine than by any other remedy. Large doses and frequent administration are unnecessary, and if carefully attended to the special influence of the remedy on consciousness need not be developed to a sufficient extent to form a habit.

Combined with atropine, cocaine becomes a valuable *hypnotic ;* for example : ℞ Cocainæ hydrochlor., gr. xv ; atropinæ sulphat., gr. ss. M., ft. pil. no. lx. Sig. : One or two at bed-hour.

The enormous value of cocaine as a local anæsthetic in ophthalmology is fully conceded, and no less useful has it proved to facilitate manipulations and to render them painless in laryngological, genito-urinary, obstetrical, and gynæcological and rectal surgery. It would be a labor of supererogation to enlarge on this topic. It has been successful in a remarkable degree in the treatment of *vaginismus, pruritus,* and cutaneous maladies in which *itching* is the most troublesome symptom. The solution used for these purposes should have a strength of five to ten per cent.

COMBINATIONS—ANTAGONISTIC AND SYNERGISTIC—OF COCAINE.

With Atropine.—Attention was called to the actions of atropine and cocaine at the time an attempt was made to float into prominence a fraudulent remedy composed of a mixture of the two. As the actions of the supposed new remedy were studied by some who are eminently qualified for the task, and as new facts were thus ascertained, it is clear that sufficient merit was found in the combination to justify some notice of it here in this form.

Actions and Uses.—A two-per-cent solution of the compound applied to the conjunctiva, or mucous membrane of any part, induces anæsthesia in about five minutes. If applied to the conjunctiva, the anæsthesia is accompanied by a mydriasis of the maximum extent, the dilatation beginning in ten to fifteen minutes, and reaching its greatest extent in twenty minutes, but remaining in that condition for twelve to twenty-four hours, and not entirely disappearing for three days. The accommodative apparatus is acted on quite vigorously, becomes paretic in ten to fifteen minutes, and completely paralyzed within a half-hour. The anæsthetic effect is induced when the solution is applied to the mucous membrane in any situation—the fauces, nares, urethra, etc. In some subjects such a degree of susceptibility to its action exists that the absorption of a minute quantity causes nausea, pallor, vertigo, and rapid action of the heart. In this respect, as in the anæsthetic action, it more resembles cocaine : in its mydriatic action and paralyzing effect on the accommodative apparatus more atropine. In the rapidity of the action on the pupil, in the degree of dilatation, and in the persistency of the mydriatic effects, it has more the action of atropine, but is more powerful and also more enduring.

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hyd., urethan, āā ʒ ij. M. Solve. To the solution add cocain. hydrochlorat., gr. ij vel gr. iv. M. Dose, ♏ x—♏ xx vel ʒ ss. As this will mix with water without separating, it becomes a convenient and powerful anodyne and anæsthetic.

Under the name *Uralia* this preparation has been brought forward recently as new, and extravagant praise given it as an anodyne.

Tropacocaine, Hydrochlorate.—Benzoyl pseudotropeine. A substitute for cocaine. Locally applied in 3-per-cent solution, in a 6-per-cent solution of common salt. It is far less toxic than cocaine, and the anæsthesia caused by it comes on more rapidly and lasts longer. In ophthalmic work it is preferred to cocaine because it does not cause hyperæmia, and does not dilate the pupil. It may be used in Schleich's method as a substitute for cocaine, and, indeed, supplant the latter in all cases.

Caffeina.—Caffeine. A feebly basic, proximate principle, obtained from the dried leaves of *Camellia sinensis* Linné (Nat. Ord. *Ternstrœmiaceæ*), or from the dried seeds of *Caffea arabica* Linné (Nat. Ord. *Rubiaceæ*), and found also in other plants.

Caffeina Citrata.—Citrated caffeine. A white, odorless powder, having a purely acid taste and an acid reaction. Dose, gr. ij to gr. x.

Caffeina Citrata Effervescens. —Effervescent citrated caffeine. This contains, with caffeine and citric acid, the materials for effervescence—sodium bicarbonate and tartaric acid. Dose, a teaspoonful in two or more ounces of cold water, and drunk while effervescing.

The salt of caffeine most worthy of consideration is the *hydrobromate.* This should not be confounded with certain proprietary compounds—more truly, mixtures—that consist of caffeine and bromides.

Some new salts of caffeine have been lately brought forward and are probably improvements on those heretofore available. They consist of *sodio-salicylate, sodio-benzoate*, and *sodio-cinnamate* of caffeine. These are soluble combinations, and can be given subcutaneously without causing local irritation. The dose for stomachal administration ranges from gr. ij to gr. xv.

Ethoxy-caffeine is a substitution product of considerable promise —ethyl replacing one atom of hydrogen in caffeine. According to Dujardin-Beaumetz, this is an excellent hypnotic and calmative. It is crystalline, has basic properties, and, although insoluble in water, its salts can be dissolved with readiness. The following formula is a convenient one for extemporaneous use : ℞ Ethoxy-caffeinæ, gr. iv ; sodii salicylat., gr. iv ; aquæ lauro-cerasi, ʒ jss ; syrupi, ℥ ss. M. Sig. : A tablespoonful as required. The addition of one and a half grain of cocaine is recommended by Dujardin-Beaumetz to increase its hypnotic action.

The so-called " citrate of caffeine " is not a chemical combination, but a mere mixture, and is recognized by the present Pharmacopœia as "citrated caffeine."

Properties.—Caffeine crystallizes in needle-shaped crystals and in prisms. It is bitter in taste, soluble in water and in alcohol. It is remarkable for the quantity of nitrogen it contains, surpassing in this respect all other alkaloids.

Caffeine in small quantity acts as a stomachic tonic, and rather improves than lessens appetite when administered in diseased states. It is feebly laxative, owing probably to its action in stimulating the glands of the mucous membrane, thus increasing secretion.

The most important function is its action on the heart and circulation. We owe more especially to Dr. Huchard and Professor Sée the modern experience in regard to its place as a cardiac remedy. It has not usually been given in quantity sufficient to produce the appropriate effects, and until recently its powers as a substitute for digitalis were not appreciated. For making a satisfactory impression on the organs of circulation not less than five grains at a dose, and fifteen to twenty grains in twenty-four hours, are required. In sufficient quantity caffeine slows the heart, lengthens the interval, and increases the power of the muscular contraction. It also raises somewhat the arterial tension by stimulating contraction of the arterioles, and it has distinct and available diuretic property. Excessive and too frequent administration of caffeine will bring on toxic effects, in which the heart becomes weak and irregular, the pressure falls, and respiration fails, death being due to paralysis of the respiratory muscles.

As regards the action of caffeine on the brain, it may be stated that, at first, drowsiness occurs; but this is soon followed by wakefulness, excitement, muscular trembling, confusion of mind, hallucinations, and delirium. The cerebral effects terminate in deep sopor, but this is probably the result of exhaustion. Rise of temperature, convulsions, general paralysis, occur when toxic doses are administered to animals; but the temperature declines when paralysis supervenes (Leven, Schmiedeberg, Bennett, and others).

Therapy.—Caffeine is a useful *stomachic tonic*. In convalescence from acute maladies it is in a high degree serviceable, given to promote the constructive metamorphosis. *Chronic catarrh* of the stomach, with occasional attacks of *migraine*, is a combination of maladies in which caffeine is especially useful. Paullinia or coca may be used instead.

In the *diarrhœa of phthisis*, in ordinary *atonic diarrhœa*, in *cholera infantum*, and in *cholera morbus*, produced by agencies affecting the nervous system, the remedies of this group, especially caffeine, are often extremely useful. When the vital powers are depressed, and when there is at the same time an abnormal excretion of urea—a condition of things which exists in incipient phthisis, associated with indigestion—caffeine, coca, and paullinia are in a high degree serviceable. They increase the appetite and the digestive power, and diminish tissue-waste.

Black coffee, or caffeine, increases the action of the heart and raises the arterial tension, and is therefore useful when the circulation is depressed from various causes.

An important use of caffeine, at present, is in the treatment of *headache.* It is adapted especially to the relief of *migraine*, the so-called nervous headache, accompanied with or without stomach-derangement. In this disorder we may administer a grain of caffeine every half-hour, until the headache is relieved ; or the bromhydrate of caffeine may be given in an effervescent draught. Elegant and useful are the granular, effervescent preparations of caffeine. They may be prepared extemporaneously by adding caffeine to the materials for effervescence —sodium bicarbonate and tartaric acid.

Caffeine has proved very useful in *cardiac dropsy ;* and in *renal dropsy* in inverse ratio to the amount of damage suffered by the kidneys, for, as Brackenridge has shown, this remedy does not increase the flow of urine when the renal epithelium is destroyed. It may be used with advantage in *ascites* when any diuretic will prove serviceable. It has, within the past two years, been much employed by the French therapeutists, in place of digitalis, in the treatment of certain cardiac affections. According to Huchard, caffeine acts more rapidly than digitalis, causing free diuresis in twenty-four hours. It slows the pulse and raises the arterial tension, thus effecting a better distribution of the blood. To bring about these desirable effects, Huchard rapidly increases the dose, so that on the third day he gives a gramme (15½ grs.) hypodermatically.

The author can confirm the observations of Dr. Huchard, by his own experience in the use of caffeine in cases of mitral incompetence with general dropsy. Having the same kind of action on the heart, not cumulative, and unirritating as digitalis, he has obtained as good results, and with far less discomfort to the patient, with caffeine.

Guarana.—A dried paste, prepared from the crushed or ground seeds of *Paullinia sorbilis* Martius (Nat. Ord. *Sapindaceæ*).

Extractum Guaranæ Fluidum.—Fluid extract of guarana. Dose, ♏ x—ʒ ij.

Composition.—It contains a principle which has been entitled *guaranine*, and which subsequent researches have proved to be identical with caffeine.

Actions and Uses.—The physiological effects of paullinia are due to its alkaloid, chiefly ; and, as this is the same as caffeine, the observations already made on the latter are equally applicable to the former. One instance has come under the author's observation, in which the use of guarana had become a habit. Every morning the lady took a considerable dose of the paste before appearing to the world. Quite a serious effort was required to wean her from it. As is the usual result, the accustomed stimulus withdrawn, digestion and assimilation became feeble, and loss of flesh occurred; but, after recovery, all was regained that had been lost.

The special use of paullinia is in the treatment of sick-headache or *migraine*. It is adapted to the so-called nervous form of sick-headache, and is less efficient when the attacks are due to stomachal troubles. As it possesses, directly or indirectly, restorative powers, it may be employed to promote constructive metamorphosis. Administered with this view, it may be given with advantage in the *convalescence from acute maladies*, in *incipient phthisis*, and in the *wasting diseases generally*.

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Theobromine.—An alkaloid obtained from *Theobroma cacao*. It is crystallizable, volatile, and is closely related in character and in molecular arrangement to caffeine. It combines with acids to form salts, is very slightly soluble in water, and has a bitter taste.

Diuretin is the proprietary designation of a combination of salicylate of soda and theobromine. Theoretically, it is a salicylate of theobromine and sodium, and should contain 54 per cent of theobromine, but it falls short of this as it occurs in commerce, containing usually not more than 40 per cent.

Under the name **Uropherin**, a combination of theobromine and salicylate of lithium has been made by Merck, of Darmstadt, and its physiological action studied by Von Gram. Heintz and Liebrecht have also lately reported on a compound salt of caffeine and salicylate of lithium and strontium. These preparations practically agree in the mode and character of their effects. In the remarks to follow, diuretin is the agent under consideration.

Actions and Uses.—Theobromine, a congener of caffeine, has been shown to possess similar properties, except that its influence on the heart is less and on the kidneys greater. Gram found the combination with salicylate of sodium to be very effective as a renal stimulant, acting especially on the secreting structure, but without any irritant effects. By Von Pawinski it is considered to raise the arterial tension and improve the tone of the heart, as shown by Bach's sphygmograph. The diuretic effect, he maintains, is due both to the action on the renal epithelium and to the increased power imparted to the heart, together with higher blood pressure. He holds, therefore, that diuretin is especially indicated in cases of cardiac dropsy. The formula proposed by him is the following: ℞ Diuretin, ʒj to ℈iv; aquæ menth. pip., f℥iij; aquæ destil., f℥ij; syr. simplicis, f℥j. M. Sig.: A tablespoonful every three hours.

Diuretin has also been used with much success in scarlatinal dropsy. Indeed, it is held by some to be especially adapted to the treatment of renal dropsies and in their acuter manifestations.

Diuretin is not without ill effects if used in rather large doses. Gastro-intestinal disorder, headache, dizziness, and other unpleasant symptoms, according to Höhne, followed the exhibition of full medicinal doses; but it is supposed that such disturbance must be due largely to idiosyncrasy. The amount which may be given daily ranges from ℈j to ʒj, according to age, the individual doses being from 3 to 10 grains.

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REMEDIES WHICH DIMINISH OR SUSPEND THE FUNCTIONS OF THE CEREBRUM AFTER A PRELIMINARY STAGE OF EXCITEMENT.

To this group belong the so-called narcotics, the anæsthetics, and some of those usually classed as antispasmodics. They all agree in these respects: their effects are expended, chiefly, on the nervous system; they first stimulate the functions of the brain, but this stage of excitement, which may be of shorter or longer duration, is followed by sopor, coma, and complete insensibility.

Alcohol.—Alcohol. A liquid composed of 91 per cent by weight (94 per cent by volume) of ethyl alcohol, and 9 per cent by weight (6 per cent by volume) of water. Specific gravity, 0·820 at 60° Fahr. A transparent, colorless, mobile, and volatile liquid of a characteristic, pungent, and agreeable odor, and a burning taste.

Alcohol Dilutum.—Diluted alcohol. A liquid composed of 41 per cent by weight and 48·6 per cent by volume of absolute ethyl alcohol.

Alcohol Absolutum.—Absolute alcohol. Ethyl alcohol containing not more than 1 per cent by weight of water.

Alcohol Deodoratum.—Deodorized alcohol. A liquid composed of about 92·5 per cent by weight, or 95·1 per cent by volume, of ethyl alcohol, and about 7·5 per cent by weight of water.

Alcohol Amylicum.—Amylic alcohol. Fusel-oil.

A peculiar alcohol, obtained from fermented grain or potatoes, by continuing the process of distillation after the ordinary spirit has ceased to come over. An oily, nearly colorless liquid, having a strong, offensive odor, and an acrid, burning taste.

Spiritus Frumenti.—Whisky. An alcoholic liquid, obtained by the distillation of fermented grain (usually corn, wheat, or rye), and at least two years old. Whisky has an amber color, a distinctive taste and odor, and a speciffc gravity not above 0·930 nor below 0·917, corresponding approximately with an alcoholic strength of 44 to 50 per cent by weight, or 50 to 58 per cent by volume.

Spiritus Vini Gallici.—Brandy. An alcoholic liquid obtained by the distillation of fermented grapes, and at least four years old. Brandy has a pale, amber color, a distinctive taste and odor, and a specific gravity not above 0.941 nor below 0.925, corresponding approximately with an alcoholic strength of 39 to 47 per cent by weight, or 45 to 55 per cent by volume.

There is a close correspondence in the alcoholic strength of whisky and brandy, especially when they conform to the official standard. Brandy differs from whisky in that it contains œnanthic and other ethers peculiar to the grape.

COMPOSITION.—A large number of bodies have been classed under the generic term of alcohols. A list of the most important of these is subjoined:

Methylic alcohol	CH_4O.
Ethylic "	C_2H_6O or $CH_4O+(CH_2)$.
Propylic "	C_3H_8O or $CH_4O+2(CH_2)$.
Butylic "	$C_4H_{10}O$ or $CH_4O+3(CH_2)$.
Amylic "	$C_5H_{12}O$ or $CH_4O+4(CH_2)$.
Caproic "	$C_6H_{14}O$ or $CH_4O+5(CH_2)$.

These alcohols are called "homologous," because they are closely related to each other, and differ by the common multiple CH_2. Ethylic is the common or ordinary alcohol, and amylic is an impurity existing in certain alcoholic beverages—for example, whisky, in which it occurs in consequence of the cupidity of distillers in carrying on the process after all the ethylic alcohol has distilled over. Absolute alcohol should be entirely free from any odor except its native ethereal odor, and no products but carbonic acid and water should result from its combustion.

Whisky is a solution of alcohol in water (48 to 56 per cent), but contains various odorous principles and ethers which impart to it its peculiar physical properties. The best specimens, doubtless, contain traces of fusel-oil, and acetic, butyric, and sometimes valerianic acids are present in it. The reactions of these acids with the alcohol result in the formation of various ethers, and hence old whisky is more fragrant, and therefore more highly prized, than the recent product of the still.

Brandy is also a solution of alcohol in water (48 to 56 per cent). It has a wine-like odor, and a hot, astringent taste. It contains a volatile oil, an ether peculiar to wines (œnanthic ether), coloring-matters, tannic acid, aldehyde, and acetic ether. The color is usually factitious: in *pale brandy*, the color is derived from the cask; in *dark brandy*, from caramel. Brandy is made artificially from high-wines by the addition of an ether (cognac, acetic or nitric), of coloring-matter (burnt sugar), and an astringent to give it the necessary roughness of taste (logwood, catechu, etc.).

PHYSIOLOGICAL ACTIONS.—Alcohol in prolonged contact with the skin, evaporation being prevented, excites a sense of heat and superficial inflammation. It coagulates albumen and hardens the animal textures. The epithelium of the mouth is corrugated by it—a result due to the abstraction of water and condensation of the albumen. In the stomach alcohol causes a sense of warmth, which diffuses over the abdomen, and is quickly followed by a general glow of the body. In moderate quantity it induces a superficial congestion of the mucous membrane—a dilatation of the arterioles—and this increased blood-supply enables the mucous follicles and the gastric glands to produce a more abundant secretion. The increased formation of the stomach-juices is doubtless somewhat determined by the stimulation of the mouths of the glands, in accordance with a well-known physiological law. The excitation of the gastric mucous membrane, when habitual, results in important changes; a gastric catarrh is established—for the mucous follicles, under the influence of repeated stimulation, pour forth a pathological secretion. The gastric glands at first simply produce an increased amount of gastric juice, but abnormal stimulation results in pathological changes in this secretion. The increased blood-supply to the mucous membrane sets up an irritation of the connective tissue, which undergoes hyperplasia; the proper secreting structure is encroached upon, and the glands suffer atrophic changes which result in still more important modifications of the gastric juice. Alcohol also affects directly the constitution of the gastric juice by precipitating the pepsin from its solution and by arresting the activity of this ferment.

In small doses, not too frequently repeated, alcohol increases the digestive power by stimulating the flow of blood and soliciting a greater supply of the stomach-juices. Large doses impair digestion directly by precipitating the pepsin, an albuminoid ferment. That a small quantity does not produce the same results in a comparative degree, is simply due to the fact that it is too far diluted, by the quantity of fluid present in the stomach, to act on the pepsin.

The structural alterations induced by the habitual use of alcohol, and the action of this agent on the pepsin, seriously impair the digestive power. Hence it is that those who are habitual consumers of alcoholic fluids suffer from disorders of digestion—gastric catarrh. The abnormal mucus which is elaborated in great quantity, acts the part of a ferment, and the starchy, saccharine, and fatty elements of the food undergo the acetic, lactic, and butyric fermentations. Acidity, heartburn, pyrosis, regurgitation of food, and a peculiar retching in the morning (morning vomiting of drunkards), are produced.

As alcohol is a very diffusible substance, it enters the blood with great facility, and probably almost all of that taken into the stomach passes into the blood from this organ, and does not reach the small intestine. The liver is consequently the first organ, after the stomach, to be influenced by the ingested alcohol. The blood of the portal vein, rendered more highly stimulating by the presence of alcohol, increases for the time being the functional activity of the liver-cells, and, as is the case with the stomach, a more abundant glandular secretion follows. Frequent stimulation and consequent over-action result in impairment or loss of the proper function of the part, as is the universal law. The hepatic cells, over-stimulated, produce an imperfect product ; they are affected by fatty and atrophic changes, and shrink in size ; and the connective tissue of the liver undergoes hyperplasia. The first result of the structural alterations is an increase in the size of the organ ; but with the shrinking of the hepatic cells, and the contraction of the newly-formed connective tissue, the liver becomes smaller, nodulated, and hardened. To this change the term *cirrhosis* has been applied. It is essentially a slowly-developing and chronic malady, and long indulgence in alcoholic liquids is necessary to its production.

In small doses, alcohol increases the action of the heart and the cutaneous circulation ; a slight general rise of temperature is observed ; and all of the functions are, for the time being, more energetically performed. If a considerable dose be taken, the phenomena of exhilaration, of excitement, of slight intoxication ensue. A still larger quantity causes loss of muscular power, impaired co-ordination of voluntary movements, and rambling incoherence. When a toxic dose is taken, the stage of excitement is of short duration ; profound insensibility, with stertorous breathing and complete muscular resolution, quickly follow.

As respects the action of alcohol on the nervous system, it is obvious that its first effect is to increase the functional activity of the brain ; the ideas flow more easily, the senses are more acute, the muscular movements are more active. These effects are coincident with the increased action of the heart, the slight rise of temperature, and the greater activity of the functions of the organism in general. With the increased action of the alcohol on the cerebrum the excitement becomes disorderly, the ideas incoherent and rambling, the muscular movements uncontrolled and inco-ordinate (over-stimulation of the cells of the gray matter). With an excessive quantity, the functions of the cerebrum are suspended, and complete unconsciousness ensues; the reflex movements cease; the functions of organic life are performed feebly; and, by an extension of the toxic influence to the centers presiding over these movements, respiration and circulation are finally arrested.

That these effects on the intra-cranial organs are due to the direct action of the alcohol has been shown. Alcohol has been discovered in the fluid contained in the ventricles, and has been distilled from the cerebral matter; and Hammond has demonstrated that it has a special affinity for nervous matter, being found in the cerebro-spinal axis and in the nerves, in greater quantity than in other tissues of the body. As a result of the direct contact, chiefly, but in part also from the variations in the intra-cranial blood-current, important structural alterations are gradually wrought in the cerebral matter. The cells of the gray matter become more or less fatty and shrunken, the neuroglia undergoes hyperplasia, shrinking and condensation of the whole cerebrum ensue (sclerosis), and the cerebro-spinal fluid relatively increases. The objective evidences of these pathological changes are seen in the impaired mental power, the muscular trembling, the shambling gait, of the drunkard.

In some subjects from sudden excess of a periodical kind, in others from a failure of the stomach to dispose, not only of aliment, but of the accustomed stimulus, a peculiar morbid state, known as *delirium tremens*, is produced. Peculiarity of the nervous system—idiosyncrasy—is an important factor in the causation of this condition, and probably also the use of alcoholic beverages rich in fusel-oil—for Richardson has shown, and the author has repeatedly confirmed the observation, that amylic alcohol causes tremors and muscular twitching "identical with the tremors observed in the human subject during the alcoholic disease known as delirium tremens."

The long-continued action of alcohol on the nervous system produces other disorders besides delirium tremens. Hemi-anæsthesia, epilepsy, paraplegia, amaurosis, etc., have been observed to result from alcoholic excess, and mental alienation, as the asylum statistics prove, has in the same agent its most influential cause.

It is necessary now to consider what becomes of the alcohol after its introduction into the human body, and the influence which it exerts, if any, in the metamorphosis of tissue. The results of experiment on these points have been remarkably contradictory; and the questions involved are by no means settled. It would require a volume to make a satisfactory analysis of the various memoirs and papers which have been published on the actions of alcohol. The author, therefore, merely presents the conclusions to which he himself has come, after a careful consideration of all the more important contributions to the literature of the subject.

A small quantity of alcohol, in a subject not accustomed to its use, causes, as has been already stated, increased activity in all the bodily functions, and slight elevation of temperature. Habit, as is the case with a great many drugs, modifies in a remarkable manner the physiological activity of alcohol, and hence these results are not perceived in the habitual consumers of this substance. Considerable doses of alcohol cause a decline in the temperature of the body, which is even more marked in pyrexia than in the normal state. As respects this effect, the influence of habit is equally great, for in old topers a decline in temperature does not follow the use of alcohol in doses short of lethal. In animals the reduction of the body-heat is more marked than in man. To what cause is the decline in temperature, produced by alcohol, attributable? This is, doubtless, referable to the diminished rate of tissue metamorphosis—for it has been ascertained that the excretion both of urea and of carbonic acid is lessened by alcohol. The combustion of the nitrogen and carbon foods is, therefore, retarded. This action is represented, objectively, by an increase in the body-weight and the *embonpoint* of those who take stimulants moderately.

The disposition of alcohol in the organism is a subject which has gone through several revolutions of opinion. At present the weight of authority and the deductions of experiment are in favor of that view which maintains that, within certain limits (one ounce to one and a half ounce of absolute alcohol to a healthy man), alcohol is oxidized and destroyed in the organism, and yields up force which is applied as nervous, muscular, and gland force. The amount of alcohol ingested, in excess of this oxidizing power of the organism, is eliminated as alcohol by the various channels of excretion—by the lungs, skin, kidneys, etc. As alcohol checks tissue metamorphosis, and thus diminishes the evolution of heat and force, it might be expected that the products of its own oxidation would supply the deficiency, but this is not the case. Alcohol is a useful food in the small quantity which increases but does not impair digestion, which quickens the circulation and gland secretion but does not over-stimulate, and which is within the limit of the power of the organism to dispose of by the oxidation processes. This amount has been pretty accurately shown, as stated above, to be one ounce to one ounce and a half of absolute alcohol for a healthy adult in twenty-four hours. All excess is injurious. North-pole voyages, military expeditions (experiences in India and the Ashantee march), and the diminished power of resistance to cold shown by drunkards, have conclusively demonstrated that alcohol does not supply the place of other foods; and that those habituated to its use, damaged as they are in their vital organs, do not possess the same endurance of fatigue and the same power of resistance to external morbific influences as do the healthy. Furthermore, clinical experience has amply proved that topers do not bear chloroform well, that they succumb more quickly to injuries and surgical operations, and that they possess much less power of resistance than the temperate to the inroads of acute diseases. While these facts rest upon the soundest basis, it is equally true that alcohol is, within certain limits, a food, and that the organism may subsist, for a variable period, on it exclusively.

It is an important clinical fact that the physiological effects of alcohol differ in different conditions of the system. In convalescence from acute diseases, in the sudden depression of the powers of life caused by the bites of venomous snakes, or from loss of blood, or from serious injury, quantities which would, in the state of health, cause profound intoxication, are taken with impunity. The extremes of life—infancy and old age—bear considerable quantities of alcohol well, and are often remarkably benefited by them. Habitual use modifies still more decidedly the immediate influence of this agent on the functions of calorification, of circulation, and of the nervous system.

The differential diagnosis of acute alcoholism (lethal dose), of opium narcosis, concussion of the brain, cerebral hæmorrhage, and hæmorrhage into the pons or medulla, is by no means easy. In the absence of the history, in any given case, it may be impossible to determine. The odor of the breath (of opium or alcohol); the state of the pupil (contracted from opium, unequal, or contracted or dilated from intracranial hæmorrhage, contracted or dilated from alcoholic intoxication); the muscular resolution (common to all these states); the slow, sighing, irregular, or stertorous respiration (may occur in either); the abolition of reflex movements (a final symptom in all), are in the nature of things fallacious. A man who has received a concussion of the brain, or had an intra-cranial hæmorrhage, may have taken opium or alcoholic stimulants in quantity sufficient to impart a distinct odor to his breath, without otherwise being distinctly affected by it. The other signs are not sufficient in themselves to enable a decision to be reached. Hence the importance of an attentive examination of the surrounding circumstances. In the absence of a trustworthy history, it were better to suspend opinion until the further developments of the case enable an exact diagnosis to be made. The numerous examples of errors fallen into by most competent observers should make the physician hesitate before pronouncing an opinion of "drunk" or "dying," in the sensational language by which some of these cases of mistake have been characterized.

The treatment of acute alcoholism consists in the evacuation of the stomach by the stomach-pump of any unabsorbed alcohol; the *cautious* inhalation of ammoniacal gas; cold affusion to the head; faradism of the muscles of respiration, external warmth, etc.

As respects the *post-mortem* appearances the following have been observed: intense hyperæmia of the gastric mucous membrane; distention of the right cavities of the heart, and of the great venous trunks; hyperæmia of the cerebral meninges, and serous effusion into the ventricles and subarachnoid spaces.

THERAPY.—Alcohol in small doses is a useful *stomachic tonic.* It is best taken for this purpose after or with meals. It is specially serviceable in the *feeble digestion of old people,* the *atonic dyspepsia of the sedentary, and in the slow and inefficient digestion of convalescence from acute diseases.* It should be prescribed with caution in these cases, especially in the atonic dyspepsia of women and of sedentary men, because of the danger that an alcohol habit may be formed. When it is prescribed in the convalescence of acute diseases, the stimulant should be withdrawn at the earliest period.

Excellent results are obtained from the use of brandy in the *apepsia of infants.* The *summer diarrhœa,* both of children and adults, may be arrested by a full dose of brandy. Irritating matters and undigested food should be removed before the brandy is administered. The vomiting of *cholera-morbus* and of *cholera* may, frequently, be arrested by small doses of iced brandy (a teaspoonful in pounded ice every half-hour), or tablespoonful doses of iced champagne. *Other forms of vomiting,* when due to irritation or inflammation of the stomach—as, for example, the vomiting of pregnancy—can sometimes be promptly cured by the same remedy. It not unfrequently happens that, in *delirium tremens,* nothing is retained by the stomach, and the life of the patient is put into imminent danger, by reason of the failure of the food-supply to the blood. A little brandy and ice will sometimes settle the stomach under these circumstances, and enable the patient to take and digest the much-needed aliment.

Notwithstanding the theoretical objections which may be urged against this practice, clinical experience is strongly in favor of the use of alcoholic stimulants to counteract the depressing influence of certain agents on the action of the heart—as, for example, *aconite, veratrum viride, conium, digitalis,* and the *poison of venomous snakes.* Before commencing the inhalation of chloroform, an ounce or two of whisky or brandy should be given the patient. This serves a double purpose: it sustains the heart and prolongs the chloroform narcosis.

Alcohol in some form is constantly prescribed in low conditions in *fevers, acute inflammations,* and *depressing maladies of all kinds.* It is serviceable in these diseases when it lessens the pulse rate, but increases the contractile power of the heart and elevates the arterial tension. It does harm when the pulse becomes more rapid and the blood-pressure is lowered by it. It does good when the tongue, before dry, becomes moister under its use, and harm when the dryness of the tongue is increased. It does good when the temperature is reduced, the delirium and subsultus lessened, and the sleep becomes more continuous and refreshing; and does harm when it increases fever, exaggerates the delirium, and induces coma vigil. The chief utility of alcohol in these forms of disease is not as a stimulant, but as a food. It furnishes material, easily oxidizable, which can be applied as nervous, muscular, and gland force. Furthermore it stimulates digestion, and enables more food to be taken and disposed of, and thus contributes indirectly to the maintenance of the powers of life. It follows from these considerations, that alcohol should be given in these low conditions of the organism, with milk, eggs, broth, and other suitable aliment.

Undoubtedly the stimulant treatment of *adynamic states* is often carried to great excess. The large doses of alcoholic substances administered, disorder the stomach and suspend digestion; and thus the condition of things which they are intended to relieve is only made worse. Furthermore, stimulants are excessively used in these disorders, from a wrong notion of their therapeutic action, and a conviction that diseases characterized by depression are best treated by arterial stimulants. The reaction which has set in against the antiphlogistic methods is in part answerable for the great freedom with which alcohol is now used in fevers and inflammations.

As respects its action on the nervous system, alcohol is a narcotic. It may be used to *relieve pain*, to *promote sleep*, and to *quiet delirium*. The various *neuralgiæ* may be temporarily alleviated by intoxicating doses of alcohol, but such a prescription is dangerous to the moral health of the patient. The subjects of neuralgia, or those who possess the neurotic temperament, have as a rule an inherited or acquired weakness of constitution, and a mobility of the nervous system, which render the effects of alcoholic stimulants peculiarly grateful.

When *wakefulness* is due to a condition of *cerebral anæmia*, a full dose of some alcoholic fluid, whisky or brandy, will procure sound and refreshing sleep. In some subjects a glass of ale or beer answers better. Some cases of *delirium tremens* are greatly benefited by alcoholic stimulants. When the delirium is the result of sudden excess and of the direct action of the alcohol on the cells of the gray matter, the use of this agent will only add to the existing disorder; but when, as is so frequently the case, the attack is determined by the failure of the stomach to appropriate not only the stimulant but the food also, the careful administration of alcoholic stimulants with suitable aliment renders an incontestable service.

As alcohol stops waste, promotes constructive metamorphosis by increasing the appetite and the digestive power, and favors the deposition of fat, it is directly indicated in *chronic wasting diseases*, especially in *phthisis*. Clinical experience is in accord with physiological data : alcohol is an important remedy in the various forms of *pulmonary phthisis*. It is frequently given with cod-liver oil, or an ounce or two of whisky may be taken with some bitter or aromatic immediately after meals. If alcohol disagrees, if it does not improve but lessens the appetite, it will do harm in phthisis. It is an interesting fact that an intractable form of phthisis is induced by alcoholic excess.

EXTERNAL APPLICATIONS OF ALCOHOL.—Equal parts of alcohol and water is an excellent evaporating lotion for the relief of superficial inflammations—*bruises, inflamed joints, orchitis*, etc. Alcohol is an excellent *hæmostatic* for restraining oozing from a large surface. For *suppurating wounds* alcohol is an efficient *antiseptic dressing*—it destroys germs, removes fetor, and stimulates the tissues to more healthy growth. It favors the cicatrization of open wounds by coagulating the albumen and thus making an impermeable covering. It is a useful practice to wash the parts threatened with bed-sores with whisky or alcohol ; it hardens the cuticle, and prevents ulceration. *Sore nipples* may be prevented by washing them with brandy after the child nurses, and then dusting them with bismuth carbonate. Brandy-and-water is an excellent lotion for *mercurial* and other forms of *stomatitis* requiring stimulant applications. Brandy-and-water is one of the thousand injections used in *gonorrhœa*.

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Vinum.—Wine.

Vinum Album.—White wine. A pale, amber-colored or straw-colored alcoholic liquid, made by fermenting the unmodified juice of the grape, freed from seeds, stems, and skins. . . . White wine should contain not less than *ten per cent* nor more than *twelve per cent* by weight of absolute alcohol.

Vinum Rubrum.—Red wine. An alcoholic liquid, made by fermenting the juice of fresh colored grapes in presence of their skins. A deep red liquid, having a pleasant odor, free from yeastiness, and a fruity, moderately astringent taste without excessive sweetness or acidity.

The U. S. Pharmacopœia for 1890 recommends that when wines, white or red, are prescribed, the domestic product, in the absence of special instruction, be employed.

Sparkling Wines. (Champagne, sparkling catawba, etc.)—These are wines which have been bottled before the stage of fermentation has been completed, hence they are lively, or sparkling, in consequence of being charged with carbonic acid. A considerable portion of the grape-sugar has not been converted into alcohol; they are sweet wines, therefore, and the quantity of absolute alcohol which they contain is relatively low (eight to twelve per cent). Sparkling hock is a lighter wine than champagne, and contains less sugar. Sparkling catawba more nearly resembles hock than champagne.

A sophistication now much practiced consists in adding to still wines carbonic-acid gas, by pressure, in the same manner that carbonic-acid water is manufactured.

Dry Acid Wines.—The best specimens of this group are the German Rhine and Moselle wines, California hock, and Ohio and Kelly-Island catawba. The German varieties are very numerous, and are remarkable for their flavor, for the completeness of the fermentation (absence of sugar), and for their permanence. The most important of the varieties are the following: Dürkheimer, Ungsteiner, Hochheimer, Deidesheimer, Förster, Rudesheimer, Johannisberger, Liebfrauenmilch, etc. The French wines are, as a rule, rather acid. The best known are the clarets, but these are more properly classed with the red wines.

Sweet Wines.—In this group are contained burgundy, still champagne, muscatel, malaga, Hungarian tokay, and angelica, madeira, etc. The alcoholic strength of these wines, unless fortified, is relatively low, because the sugar has not been consumed by the fermentation.

Light Red Wines.—The French clarets, the red Rhine wines, the American Ives's seedling, and Concord and Hungarian, are members of this group. They contain a large proportion of the coloring-matter of the grape, and considerable tannic acid.

Heavy Red Wines.—Port is the principal representative of this group, but it is not a natural wine; during the process of manufacture spirit is added, and its alcoholic strength is raised to thirty or forty per cent. California port when fortified, as it probably frequently is, should be classed in this division.

Dry Spirituous Wines.—The most important member of this group is sherry.

COMPOSITION AND PROPERTIES.—The composition of wine is extremely complex. The constituents ascertainable by chemical analysis do not represent all of the peculiar qualities which render various wines desirable. Bouquet and flavor can not be determined by the most expert chemist, and elude all other means of investigation but the tongue and nose of the "wine-taster."

A wine is a solution of alcohol in water, mixed with various constituents of the grape. The proportion of alcohol ranges from six to forty per cent—the largest quantity being found in the artificial wines, such as port and sherry. The proportion of sugar varies greatly—from three to twenty-five per cent. The acids are fixed (tartaric) and volatile (acetic). The relation between these several constituents is nearly as follows: Port contains about fifty-three parts by weight of alcohol to one part of acid, and twelve parts of sugar to one part of acid. The average of sherry is thirty-nine of alcohol and 1·5 of sugar to one of acid. In the sweet wines, the average is about thirty parts of sugar to one part of acid and fifteen parts of alcohol. In the acid wines, the average proportion of alcohol to acid is as eighteen to one, while the sugar is almost absent, and in some of the best is entirely so. Those are *dry wines* which are free from sugar. Besides tartaric and acetic acids, wines contain, in much smaller quantity, malic, tannic, and carbonic acids. Wines containing less than three hundred grains of acid to the gallon are wanting in flavor; on the other hand, an excess of acid over five hundred grains to the gallon is too sour to be agreeable. The coloring-matter of wine varies greatly, and the distinction between "white" and "red" depends on the quantity present in these different varieties. The red wines are more astringent, due to the larger proportion of tannin which they contain, and they are also rougher to the taste.

Wine contains a great many mineral constituents; tartrates of potassa and lime, chlorides of sodium, potassium, and calcium, and sulphates of potassa and lime. The percentage of ash ranges from 0·18 to 0·40.

NOTE.—The wine-consumers of the United States have been so long habituated to the wines of foreign source, that they have been unable to overcome the prejudices against the wines of native production. The vineyards of California, of the interior lakes, and of various parts of the Middle States now produce wines so thoroughly good, that a revision of the present standards of taste is demanded alike in the interests of consumers and producers. A sound taste and patriotism coincide in claiming the highest excellence for our native wine.

The peculiar odor of wine (bouquet) is due to œnanthic acid, and œnanthic ether, produced by a reaction of the acid on the alcohol.

According to Fresenius, the quality of a wine is so much the better *the less it contains of free acid, the more it contains of sugar, and the greater its quantity of extract;* and, further, its quality is not decidedly influenced by the quantity of alcohol, and can not be determined by its specific gravity.

A certain quantity of free acid is necessary, but it should not be greater than can be masked by the alcohol, sugar, and extractive matter. The flavor and odor of wine are produced by ethers formed by the action of the free acid on the alcohol; hence the importance of this acid constituent.

Dr. Druitt, in his "Report on Cheap Wines," has very well summed up the qualities of good wine in the following conclusions:

"1. The wine should have an absolute *unity*, or taste as one whole.

"2. Wine should contain a certain amount of alcohol.

"3. Wine should be slightly sour.

"4. Sweetness is characteristic of a certain class of wines, while certain other wines are *dry*, or free from sugar.

"5. Wines should have a taste free from mawkishness, and indicative of instability.

"6. Roughness or astringency is a most important property, and belongs to most red wines. In moderation it is relished, as sourness is, by a healthy, manly palate, just as the cold souse is welcome to the skin. In excess it leaves a permanent harshness on the tongue.

"7. The wine must have *body*. This is the impression produced by the totality of the soluble constituents of wine—the extractive, that which gives *taste* to the tongue, and which, as wine grows older, is deposited along with the cream of tartar forming the *crust*.

"8. *Bouquet* is that quality of wine which salutes the nose. *Flavor* is that part of the aromatic constituent which gratifies the throat.

"9. The wine must *satisfy*. A man must feel that he has taken something which consoles and sustains. Some liquids, as cider and thin wines, leave rather a craving, empty, hungry feeling after them."

Physiological Actions.—As respects the alcohol which they contain, the physiological actions of wines could be discussed with the previous article. But wines differ from alcohol, and from brandy and whisky, not only in spirituous strength, but in the possession of the varied and important constituents mentioned above.

The sparkling wines are more sedative to the stomach, and are more intoxicating, relatively to their alcoholic strength, than the other wines. As they contain a considerable quantity of unappropriated sugar, acid fermentation is apt to occur, and acidity, with headache, follows their use. As respects the influence on the pulse, they are less stimulating than the stronger wines, and the experiments of Dr. Edward Smith have demonstrated that they increase the excretion of carbonic acid.

The dry acid wines are more purely stimulant, partly in consequence of their alcohol, and partly in consequence of the important ethers which they contain. As they are free from sugar, acid fermentation does not follow their use, but with some subjects the free acid present in them disagrees.

The sweet wines have, generally, considerable body and alcoholic strength. They rather pall on the appetite; are apt to disorder the stomach, and produce headache. Some of them have fine bouquet and flavor, and are satisfying to the palate; but as a rule they are not borne as well as the dry wines.

The red wines, light and dark, are astringent and have considerable body and alcoholic strength. The tannin which they contain, and coloring-matters, are apt to cause stomach-disorders, constipation, and a febrile state. By reason of the large amount of alcohol in them, especially in port, they approach whisky and brandy in power as stimulants and narcotics.

THERAPY.—

> "Good wine is a good familiar creature, if it be well used." (Othello.)

The effervescing or sparkling wines often render important service in irritable states of the stomach without inflammatory action. The *vomiting* of *pregnancy*, of *sea-sickness*, of *yellow fever*, of *cholera-morbus, with depression*, and of *true cholera*, are not infrequently arrested by tablespoonful-doses of iced champagne every fifteen minutes.

A generous glass of a dry wine (sherry) taken with the principal meal greatly assists the digestion of the sedentary who suffer from *atonic dyspepsia*. The wine should be taken during the course of the meal, and at no other time. Persons who suffer from *acidity*, due to an excess of formation of acid gastric juice, are relieved by a dry acid wine, taken during the meal or just previously. For this purpose a genuine Rhine wine—for example, Förster Riesling—is best.

In *diarrhœa* and *dysentery*, after the acuter symptoms have subsided, and when there is considerable depression, those wines are indicated which contain tannin—the red wines, claret, Ives's seedling, port, etc.

In cases of *anæmia and chlorosis*, wines render an important service by increasing digestion and assimilation. To aid in this process, red wines with a good deal of sugar and extractives are most necessary. When wines produce headache, and the digestion is disordered by them, and the appetite impaired, they are not serviceable in these maladies. Moreover, for the nervous and hypochondriacal, wines must be prescribed with caution, for the habit of indulgence is quickly acquired by such subjects. In *convalescence from acute diseases*, there can be no difference of opinion as to the great value of wine as a restorative. Wines of considerable body and alcoholic strength are indicated under these circumstances. When there is much nervous restlessness, wakefulness, and cardiac depression, a wine rich in ethers is specially useful, according to Anstie. In chronic wasting diseases, as *phthisis, scrofula*, etc., the stronger wines, as sherry, burgundy, port, may take the place, in some cases, of the spirits, whisky and brandy. In these wasting diseases, wines serve a double purpose: they stimulate the activity of the primary assimilation, and within certain limits they are utilized as foods. They are only harmful when digestion is impaired by them; and under no circumstances can they take the place of other aliment.

In *passive hæmorrhages*, in the *hæmorrhagic diathesis* and in *purpura*, wines are indicated, because they elevate the arterial tension, and thus act indirectly as hæmostatics.

In various *acute diseases*, when the *action of the heart becomes feeble* and *irregular*, the *pulse dicrotic*, and there occur *wakefulness* and *delirium*, a wine of considerable alcoholic strength and rich in ethers is peculiarly serviceable. Wines are much more largely used in fevers (*typhoid, typhus*, etc.) than in any other forms of disease, and the circumstances requiring their employment are indicated in the preceding sentence. The routine practice of alcoholic stimulation in fevers can not be justified. Exact indications for the use of wine exist in the state of the heart and arterial system, and of the brain, and these should be sought for in every case, instead of prescribing for the name. In fevers, wines precede the spirituous liquors. The first weakening of the heart's action, the beginning of dicrotism, and the transitory delirium and subsultus, require champagne and the light and acid wines; more profound adynamia, with diarrhœa, the stronger red wines.

In *acute inflammations* (*pneumonia, pleuritis, peritonitis*, etc.), wines serve to maintain the strength when the powers of life are weakening, or to maintain the functions of brain and heart when crises occur, as in pneumonia. The rules for the administration of wine in acute inflammations are the same as in fevers.

Next to their use in fevers, wines are most frequently prescribed, and with the greatest advantage, in *surgical practice*, for the *consequences of wounds* and *injuries*, to *support the powers of life under protracted and profuse suppuration*, and to favor digestion and assimilation in the course of convalescence from surgical diseases.

The immediate stimulant effect of wine is of great value in *sudden and profuse loss of blood*, whether from injuries and surgical operations, or *post partum*. A highly-etherized wine of good body is most useful here, because it produces a prompt effect and easily yields up the force needed to keep the heart and brain in action, and, in the case of the relaxed uterus, to furnish the power needed to procure its energetic contraction.

Beer, Ale, Porter.—*Beer* and *ale* are fermented liquors made from malted grain, hops and other bitter substances being added. Ale is produced by rapid fermentation, in which the yeast rises to the surface, and beer is the product of slow fermentation in cool cellars, the yeast falling to the bottom. Hence the name *lager-beer*. *Porter* embraces the qualities of beer and ale, and is so named on account of its strong quality, which endeared it to porters.

COMPOSITION.—The proportion of alcohol varies somewhat. In Edinburgh ale it amounts to about six per cent; in brown stout, to six per cent; in porter, to four per cent; in beer, two to three per cent. Besides alcohol and water, these malt liquors contain extract of malt, five to fourteen per cent; carbonic acid, 0·16 to 0·60 per cent. In the extract are found also various aromatic substances, lactic acid, potash and soda salts, etc.

PHYSIOLOGICAL ACTIONS.—So far as the alcohol is concerned, beer, ale, and porter correspond in physiological actions to the spirituous liquors and to wines. As they contain malt extract, their nutritive value is greater than spirits and wine. An important constituent, the hop, being an aromatic bitter, the tonic and stomachic qualities of these malt liquors are also greater than their congeners. The process of fermentation, however, lessens in a remarkable degree the nutritive and stomachic qualities of the constituents which enter into the composition of malt liquors. Their value as foods is much exaggerated by the habitual consumers. They increase the appetite and favor the deposition of fat. Although the malt beverages do not cause to anything like the same extent the alterations in the nervous centers produced by the spirituous, they induce other and almost as important structural changes. They set up in the organism fatty degeneration of various tissues, notably of the liver and heart. The habitual beer-consumer is known by his obesity, his flushed face, embarrassed breathing, puffy hands, yellow conjunctiva, etc.; he is usually short-lived, and the end is reached by hepatic and cardiac disorders. It is certainly true that a moderate amount of beer may be taken daily, for a lifetime, without any obvious impairment of the functions; but excessive use produces with great certainty the unfavorable effects above described.

THERAPY.—Beer, ale, and porter are not usually prescribed in acute maladies. They are, however, much and justly esteemed as *stomachic tonics* and *restoratives* in chronic wasting diseases—for example, in *convalescence from acute diseases* and *surgical injuries*, in cases of *profuse* and *protracted suppuration*, *prolonged lactation*, *diseases of the joints*, *scrofula*, *phthisis*, etc. Strumpf finds, however, that alcoholic beverages only increase the amount of fat in milk, and not the quantity of milk as a whole.

The malt liquors are harmful in all stomach-disorders with acidity, and in chronic affections of the liver, especially fatty liver. When these beverages do not improve the appetite, when they cause a sense of epigastric oppression, and when they coat the tongue, they are not beneficial.

When *wakefulness* is due to cerebral anæmia, a glass of beer or ale at bedtime will frequently produce satisfactory sleep. *Puerperal mania*, *delirium tremens*, and *acute maniacal delirium*, when these symptoms coexist with a condition of adynamia, are greatly benefited by the liberal use of ale (pale or Edinburgh ale). The effect of this remedy is to arouse the appetite, to quiet delirium, and to produce sleep. In *melancholia*, excellent results are often obtained by the use of porter with a little tincture of opium.

EXTRACT OF MALT.—Under this name is known a thick, sirupy liquid having a golden or yellowish-brown color, a sweetish taste, and the odor of malt. If properly prepared, it contains, besides the constituents of barley, the ferment *diastase*. It is much prescribed for its restorative qualities, and as a vehicle for cod-liver oil. It is best administered immediately after meals.

Paraldehyde.—Under this name is described a polymeric modification of aldehyde. Above the temperature of 51° Fahr. it is a colorless liquid, having a peculiar ethereal odor, and a specific gravity of ·998. It boils at about 225° Fahr. It is soluble in eight parts of water at 52° Fahr. The dose ranges from ʒ ss to ʒ ijss. Water is a suitable menstruum.

In appropriate cases it has proved to be an admirable hypnotic, with many of the qualities but none of the dangers of chloral. In its action, first the cells of the cerebrum are affected, and sopor is induced. Unlike the other agents of this class, its soporific action is not preceded by excitement (Cervello). Next to the cerebral hemispheres the effects of paraldehyde are expended on the medulla oblongata, and then on the spinal cord. A lethal dose stops the functioning of the medulla and the respiratory center, but the cardiac functions cease after the respiratory. It differs from chloral in the important respect that it has no paralyzing action on the heart. The effect of paraldehyde is, however, not so persistent as that of chloral, but frequent administration of the one can safely compensate for the greater power of the other (Albertoni).

Paraldehyde may be prescribed as a hypnotic in the conditions usually requiring such a remedy—in *fevers*, *rheumatism*, *gout*, *prurigo*, etc. (Morselli). It is, however, in mental and nervous disorders that it is likely to be most employed. By the Italian physicians, to whom we owe its introduction, it has been very successfully used in *acute mania*, in the wakefulness of *dementia paralytica*, in *hysterical seizures*, and in ordinary *insomnia*. To succeed, it must be given in sufficient quantity. The maximum dose mentioned above (ʒ ijss) has often been given without any ill effect or any after-trouble of any kind, and has often proved to be necessary.

Paraldehyde has gained in favor since its introduction, and the range of its application has constantly widened. It has been used with success in the treatment of *delirium tremens*, in *strychnine-poisoning*, in the milder cases of *neuralgia*, and as an *expectorant*; but in the more dangerous affections the dose must be large enough to make an impression—from ʒ ss to ʒ ij. These large doses are the safer, in that paraldehyde has no depressing action on the heart and lungs (Coudray). An increasing use as an expectorant, and as an ingredient of cough-mixtures, confirms what has been stated of its beneficial effects in the treatment of cough, and bronchial affections in general.

Although paraldehyde has an agreeable, fruity odor, the taste is rather pungent, and hence it were better given in the form of the prescriptions below:

℞ Paraldehyde, ʒ j; spirit. chloroform., ♏ xv; pulv. tragacanth. com., ℈ j; syrp. aurant. cort., ℥ ss; aquæ ad ℥ iij. M. Sig.: One or two doses (Hodgson).

℞ Paraldehyd., ʒ ij; ol. amygd. ex., ʒ ij; chloroformi, ♏ x; ol. cinnamomi, ♏ ij.

Authorities referred to:

Coudray, Dr. *Thèse de Paris*, 1885, quoted by *Annuaire de Thérapeutique*, 1885.
Desnos, Dr. *Bul. Gén. de Thérap.* for 1886.
Dujardin-Beaumetz, Dr. *Ibid.*
Keraval et Nerkam. *Annuaire de Thérap.* for 1886.
Prevost, Dr. J. L. *Bul. Gén. de Thérap.* *Ibid.*

Methylal.—This new agent has been long known to chemists, but its utilization as a remedy is very recent. Methylal is highly volatile, is soluble in water and alcohol, and can be made into a homogeneous unguent with oils and fats. It is a very diffusible substance, acts very quickly, and is eliminated rapidly. When it enters the stomach a sensation of warmth is produced which diffuses throughout the system, the vascular tension falls, the heart beats rapidly, respiration is increased, and the temperature is said to be lowered; but we are inclined to think that an error of observation has been committed here. Sleep is soon induced, but the extent and duration of this stage of the action are much influenced by the quantity given and by the rate of elimination, which is rapid or slow, according to the state of the eliminating organs.

Methylal lessens the reflexes, and is antagonistic to strychnine and the tetanizers in general.

The dose of methylal ranges from five to fifteen grains. As it is soluble in water it may be given subcutaneously as by the stomach. The maladies in which it has been used with encouraging results are *wakefulness*, convulsive diseases, as *epilepsy*, in neuroses of the respiratory organs, and in cases of *neuralgia* of superficial nerves. It is applied externally, mixed with almond-oil or alcohol, in the proportion of ten to twenty per cent of the medicament. The rate of dosage must be comparatively rapid, as the diffusion and elimination of the remedy go on so quickly. In making external applications, the state of the skin and its idiosyncrasies must be heeded. Violent inflammation may be caused by too free and too frequent application of the remedy.

Chloride of Methyl.—In 1884 Debove published a paper on the anæsthetic and analgesic properties of methyl chloride. But little attention was given to the subject. Very recently he has reported a fresh series of cases, and the actions of the new anæsthetic have been examined into with more zeal. He reports the treatment of one hundred and fifty cases of *sciatica*, of which only one in twenty failed of relief. He again asserts that *lumbago* and *nerve-pain* are cured immediately, and if relapses occur, they are quickly ended by renewed use of the remedy. Of the cases of *facial neuralgia*, eighteen in number, sixteen were cured.

Debove gives precise instructions about the mode of applying the remedy. As a volatile, ether-like material, rapid evaporation takes place when it is applied by the spray-douche over the affected area. An ordinary atomizer suffices. The spray should be applied over as many nerve-filaments as possible, but it is necessary to avoid producing an inflammation of the skin or an erythema. Persons having an irritable skin or a tendency to disease of the skin must be treated with caution and with the minimum of effect at the outset. Debove advises discretion in the case of those affected with albuminuria and diabetes.

The special advantage possessed by methyl chloride is the external application, which never involves more serious results than some temporary irritation of the skin; and, if the reports of its success be dependable, we have in this method the power to cure in a more ready, easy, and effective manner than ever before.

Authorities referred to:

Debove, Dr. *Société médicale des Hôpitaux*, in *Revue de Thérap.*, 1887.
Elay, Dr. *On Methylal*, *London Medical Record*, May 16, 1887.

Urethan.—A combination of carbonic acid and ethylic ether. From *a priori* considerations, the distinguished pharmacologist of Strasburg, Professor Schmiedeberg, was led to the conclusion that these compounds of ethyl must have the hypnotic powers, to some extent, of the group. A careful investigation confirmed this view. Of these ethyl compounds, called *urethans*, he found that the carbamate of ethyl was the most satisfactory, and to this he gave the generic name of the group, *urethan*. He submitted this to a characteristically thorough examination, and was thus able to confirm his original conception of the physiological actions.

PROPERTIES.—Urethan occurs in whitish crystals, is without odor, is tasteless, and insoluble in water. The dose is very unequal, for so much depends on the purpose in view, the age, character, and susceptibility of the patient. The dose may be stated as from five grains to a drachm or more. The best form in which to administer it is the compressed pellet, but the capsule, the wafer, or simple powder may be employed. It has been ascertained of late, that the best hypnotic action can be developed only by massive doses. Saundby, however, narrates two cases of insomnia in which two grains at a dose seems to have been sufficient for the purpose; but the general opinion is that from forty to eighty grains must be given to bring about a decided hypnotic action.

Urethan has no irritating effect on the stomach, and does not impair digestion. Although insoluble in water, the stomach juice dissolves it readily, and hence it promptly diffuses into the blood. Two results, apparently opposite in character, are produced in due order: the first impression is of a stimulant character, but very brief in duration; the next consists in diminution of action, slowing of circulation and respiration, decline of temperature, and weakening of the reflexes, which gradually lessen in promptness and finally disappear. With the onset of the depression stage, drowsiness comes on, tranquil sleep succeeds, and this physiological condition passes into coma and insensibility if the quantity administered be toxic. Urethan is not actively toxic, however, for Prof. Anrep maintains that so large a quantity as eight to twelve grammes (ʒ ij — ʒ iij) can be taken by an adult, without causing danger-symptoms. By Jaksch, one gramme (15½ grs.) is held to be sufficient to cause sleep. Mairet and Combemale administered it in various forms of mental diseases, and thus ascertained how far its hypnotic power is influenced by the character of the case, the presence of pain, and other disturbing influences. Urethan is not an analgesic, and hence pain will prevent its hypnotic action. The excitement of mania, noises, and odd situations, may also prevent the hypnotic action. The most frequent cause of dissatisfaction is insufficient quantity, for then the desired action fails, and consequently the remedy is discredited.

Unpleasant after-effects do not occur unless stomachal troubles interfere, and headache, nausea, and vertigo are quite exceptional. When the conditions are favorable, sleep comes on in fifteen minutes to an hour, is quiet, and lasts from six to eight hours. When it is administered for many days in succession its power lessens, although the dose may be increased; but if stopped for a time, the susceptibility of the brain is restored, and then urethan can be resumed again.

THERAPY.—The therapeutical applications of urethan are based on its physiological properties. Schmiedeberg began the consideration of its actions for *a priori* reasons, and, these being confirmed, he extended his investigations to the physiological and therapeutical aspects of the subject. Its hypnotic powers, its influence over the reflexes, and its antipyretic action, were accurately mapped out by the great pharmacologist, so that now the value of the new agent is known, its limitations are defined, and the morbid states to which it is applicable clearly shown.

In general terms, urethan is a hypnotic which may be successfully used to procure quiet and sleep, when the conditions are favorable to its action. As a hypnotic, its position is similar, but not quite equal, to that of paraldehyde.

Urethan is antagonistic to strychnine, but only the largest doses, under the most favorable circumstances, will make it powerful enough. Being a moderator of reflex action, it may prove useful in epilepsy, chorea, spasm, and cramp. It is probable, also, that it may be beneficial in the spasmodic respiratory neuroses. By way of illustration, the experiences of Dr. Ferreira may be referred to here. Cases of *epilepsy*, of *uræmic convulsions*, of *tetanus*, and of *delirium tremens*, were all influenced favorably, but a distinctly curative effect was manifest in some of the epileptic subjects, and in the cases of delirium tremens. Urethan should have further trial in the treatment of epilepsy, especially in those nocturnal in occurrence.

Phenyl-urethan.—*Euphorin.*
Chloral-urethan.—*Ural*, or *Uralium.*
Ethyl-chloral-urethan.—*Somnal.*
Acetyl-hydroxy-phenyl-urethan.—*Neurodin.*

From a combination of aniline and carbonic acid compound ethers are derived in great numbers by substitution. Of the ethyl carbamic ethers we have ethyl-carbamic ether, or urethan; phenyl-urethan, named euphorin; chloral-urethan, or uralium; ethyl-chloral-urethan, or somnal; and acetyl-hydroxy-phenyl-urethan, or neurodin.

Although these derivative combinations agree in having antiseptic, antirheumatic, antithermic, and analgesic properties, they differ in many respects, these distinctive qualities being modified by the introduction of substitutes having certain special features.

In euphorin the analgesic and hypnotic qualities of urethan are attempted to be supplemented by the antiseptic powers of phenol. Accordingly, it has been found to possess the qualities and powers of the compound ethers, and is hypnotic, analgesic, antipyretic, and antiseptic.

Euphorin is a whitish powder, a little pungent in taste, somewhat aromatic in odor, soluble in alcohol but very slightly soluble in water. The dose ranges from 0·5 g. (= 7½ grains) to 1·0 g. (= 15 grains). It is usually administered in pill form, or preferably in wafer or capsule. It is also applied locally as a powder, or mixed with talc and other diluents, or made in ointment with lanolin or vaseline.

In full doses it depresses febrile temperature, sweating marking the end of the action, and some chilliness occurs with the initial rise of temperature. In *rheumatic fever* and in *typhoid* two or three doses in twenty-four hours are usually required. As it does not cause depression of the heart, and but little cyanosis attends its action, it is a safe and useful antipyretic in typhoid. It is one of the best of its class in the treatment of acute rheumatism. Having analgesic power, it is employed in the treatment of *neuralgic affections, myalgia, lumbago*, and kindred maladies.

As a topical remedy it is used in skin and venereal affections, and as an antiseptic in wounds, injuries, and local catarrhal affections.

Chloral-urethan, or *uralium*, is an efficient hypnotic, not so powerful as chloral but more active than urethan. It is employed as a sleep-producing remedy under the same conditions as chloral. To procure sleep, a dose of 15 to 40 grains is necessary. As its action is slower than chloral and more rapid than urethan, it should be given an hour or two before the time when sleep is desired. As it is possessed of antispasmodic properties, uralium may be administered in *tetanus, chorea, epilepsy*, and similar affections.

Ethyl-chloral-urethan has been named *somnal*, a proprietary compound having a hypnotic action. Somnal is a colorless liquid with a hot, pungent taste. The dose as a hypnotic ranges from fifteen minims to half a drachm. Differing from uralium in having an additional ethyl to the hydroxyl in chloral, it is supposed to possess greater sedative and hypnotic action. Opinions differ as to its utility in insanity, in which it has been chiefly employed. Some regard it as uncertain, but Memmo has had excellent results from its administration in epileptic mania, paranoia, and other mental disorders. It is said to leave no after-troubles.

Acetyl-hydroxy-phenyl-urethan.—*Neurodin* differs from the preceding in the introduction of acetyl. According to Von Mering, it has valuable pain-relieving power, and is an efficient remedy for *neuralgia, headache, sciatica, lumbago*, and other painful affections. The dose which has been found sufficient in these affections is from 15 to 23 grains. It has been used as an antipyretic in febrile diseases—in *pneumonia, typhoid, scarlet fever*, and *erysipelas*. No dangerous symptoms have attended its action, although considerable sweating and some cyanosis have occurred. The sleep-producing effects occur within two hours, and the decline in temperature comes on within a half hour, reaching its maximum in about two hours.

Hypnone.—Under this title *phenyl-methyl-acetone* has been brought forward by Popof and Nencki as a representative analgesic and hypnotic. Dujardin-Beaumetz and pupils have followed with clinical investigations, in which the claims made have been largely confirmed.

It is a limpid, colorless liquid, odorless, but has a pungent taste. The dose is 2 to 5 minims. It should be administered in capsules, or made into an emulsion.

Hypnone has been successfully employed in the treatment of painful affections of the fifth nerve, *tic-douloureux*, rheumatic disturbances of the dental branches of the same nerve, in *hemicrania*, and similar disorders. It is applicable to the treatment of other neuralgic affections and so-called rheumatic muscular troubles, as *lumbago*, *sciatica*, etc.

Hypnone also is a moderator of reflex actions, and has been utilized in the treatment of *epilepsy*, *chorea*, and allied diseases. As respects epilepsy, it is more especially the nocturnal affection to which it is applicable. *Asthma*—the spasmodic variety—*whooping-cough*, *singultus*, are also disorders amenable to its action. Such spasmodic and painful affections as *hepatic* and *renal colic*, *flatulent colic*, etc., are conditions to the treatment of which it may be successfully applied.

Hypnal.—Under this title a combination of antipyrin and chloral—*trichloral-dehydphenyl-dimethylpyrazolon*—has been introduced. It has so many chemical, physiological, and therapeutical affinities with the remedies now under consideration that it may well be described in this place.

Hypnal is without odor or taste ; it occurs in rhombic prisms, and is soluble in water in the proportion of one to five or six parts. It may therefore be given in solution in water, or combined in suitable mixtures. The dose ranges from 10 to 40 grains.

As its composition indicates, hypnal is possessed of hypnotic, analgesic, and antipyretic actions. It has been employed successfully for the relief of *insomnia*, *hemicrania*, and other kinds of *neuralgia*, and to reduce *abnormal temperature*. Unusual exemption from after ill consequences is claimed for this agent. It is said to cause little or none of the cardiac depression, the profuse sweating, the chills, etc., which attend on the action of its congeners, antipyrin and chloral. When massive doses are given, however, the usual precautions against accident should be taken.

Butyl-hypnal differs from ordinary hypnal in being a combination of antipyrin and butyl-chloral. It has not been much used hitherto.

Hypnone is a hypnotic, and has less pain-relieving power. It is adapted to the same conditions as those in which paraldehyde is now prescribed. Dubois advises the use of hypnone to promote anæsthesia when chloroform is administered. But its chief employment will be confined to the more simple cases of *insomnia*, we conclude after some investigation of its powers.

Æther.—Ether. *Éther*, Fr.; *Aether*, Ger.

A liquid composed of about seventy-four per cent of ethyl oxide, and about twenty-six per cent of alcohol containing a little water. Specific gravity about 0·750 at 60° Fahr.

Æther Fortior.—Stronger ether. A liquid composed of about ninety-four per cent of ethyl oxide, and about six per cent of alcohol containing a little water. Specific gravity not higher than 0·725 at 60° Fahr.

A thin, very diffusive, clear, and colorless liquid, of a refreshing, characteristic odor, a burning and sweetish taste, with a slightly bitter after-taste, and a neutral reaction. It is soluble in all proportions in alcohol, chloroform, benzol, benzin, fixed and volatile oils, and dissolves in eight times its volume of water at 60° Fahr. It boils at 98·6° Fahr. Ether is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.

Spiritus Ætheris.—Spirit of ether. Consists of ether, thirty parts; alcohol, seventy parts. Dose, ♏ x—ʒ j.

Spiritus Ætheris Compositus.—Compound spirit of ether. Hoffman's anodyne. (Ether, alcohol, and ethereal oil.) A colorless, volatile, inflammable liquid, having an aromatic, ethereal odor, and a burning, slightly sweetish taste. Its specific gravity is 0·815. It is neutral, or but slightly acid to litmus. It gives only a slight cloudiness with chloride of barium; but when a fluid ounce of it is evaporated to dryness with an excess of this test, it yields a precipitate of sulphate of barium, which, when washed and dried, weighs six and a quarter grains. When a few drops are burned on glass or porcelain, there is no visible residue, but the surface will have an acid taste and reaction. A pint of water, by the admixture of forty drops, is rendered slightly opalescent. Dose, ♏ x—ʒ j. (Pharm. 70.)

Spiritus Ætheris Nitrosi.—Spirit of nitrous ether. Sweet spirit of nitre. An alcoholic solution of ethyl nitrite, containing five per cent of the crude ether. (U. S. P.) Is a volatile, inflammable liquid of a pale-yellow color, inclining slightly to green, having a fragrant, ethereal odor, free from pungency, and a sharp, burning taste. It slightly reddens litmus, but does not cause effervescence when a crystal of bicarbonate of potassium is dropped into it. When mixed with half its volume of official solution of potassa previously diluted with an equal measure of distilled water, it assumes a yellow color, which slightly deepens, without becoming brown, in twelve hours. A portion of the spirit in a test-tube half filled with it, plunged into water heated to 145°, and held there until it has acquired that temperature, will boil distinctly on the addition of a few small pieces of glass.

Spirit of nitrous ether has a specific gravity of 0·837, and contains five per cent of its peculiar ether. It should not be long kept, as it becomes strongly acid by age. Dose, ʒ ss—℥ ss.

Æther Aceticus.—Acetic ether. Acetate of ethyl. A transparent and colorless liquid, of a strong, fragrant, ethereal, and somewhat acetous odor, a refreshing taste, and neutral reaction. Soluble in all proportions in alcohol, ether, and chloroform, and in about seventeen parts of water. Specific gravity, 0·889 to 0·897. It is inflammable. Dose, ♏ x—ʒ j.

Ethyl Bromide.—Hydrobromic ether. Is a colorless liquid, volatile, having a fragrant odor, and a hot, somewhat sweetish taste, afterward rather bitter. It is not inflammable. Its specific gravity is 1·420, and it boils at 104° Fahr.; readily decomposes on exposure to light and air, bromine being separated. It is freely soluble in alcohol and ether, but very sparingly in water. Dose, for internal and subcutaneous administration, ♏ x—ʒ j.

Antagonists and Incompatibles.—Ether dissolves iodine, bromine, corrosive sublimate, the volatile and fixed oils, many resins and balsams, tannin, caoutchouc, most of the alkaloids, sulphur, and phosphorus—the last-named two sparingly. As respects its stimulant and anodyne properties, it is antagonized by arterial sedatives, quinine, oxygen, protoxide of nitrogen, the tetanizing alkaloids, strychnine, picrotoxin, etc.

Synergists.—Alcohol and its congeners, chloroform, arterial stimulants, cerebral stimulants, etc., assist the action of ether.

Physiological Actions.—The physiological effects of ether when inhaled require separate treatment; hence the subject of anæsthesia by vapors will be discussed in a special article. It is now proposed to treat of the effects of ether administered by the usual route—the stomach.

Ether has a taste at first sweetish, but afterward hot and pungent. It leaves a cooling sensation in the stomach after the subsidence of the burning, and this quickly diffuses over the body. Increased action of the heart, flushing of the face, warmth of the surface, with increased diaphoresis, follow in a few minutes. The senses are quickly excited, the mind becomes more active, ideas flow rapidly, and the cerebral phenomena of alcoholic intoxication ensue. These effects are of short duration, and a feeling of content, mental calm, and sopor, succeeds to the transient excitement. Ether is eliminated rapidly, chiefly by the lungs, and the whole duration of the effects of even a large quantity (ʒ ij) does not exceed an hour.

THERAPY.—Before it is administered, ether should be diluted with alcohol, which renders it readily miscible with water.

A few drops of Hoffman's anodyne (♏ x—♏ xx) in some camphor-water is an excellent remedy to expel *flatus* from the stomach. *Gastralgia* may often be quickly relieved by the same means. A few drops of ether, added to cod-liver oil, enable the stomach to bear it more easily, and, it is said, favors its digestion ; that it accomplishes this object by increasing the pancreatic juice, is the observation of Claude Bernard. Paroxysms of *hepatic colic* are sometimes treated by the internal administration of ether, but this treatment is by no means equal in effectiveness to the inhalation of the vapor. Ether mixed with turpentine has the power to dissolve *hepatic calculi*, hence the remedy of Durande. As Trousseau well remarks, chemical results which take place in the laboratory are not reproduced in the body with equal facility. The rapidity with which ether diffuses into the blood at the temperature of the stomach would appear to preclude the possibility of its exerting any solvent action on a calculus fixed in an hepatic duct. Whatever good result is secured by the administration of the remedy of Durande must be ascribed to the anodyne and antispasmodic action of its constituents.

Sudden failure of the heart's action (syncope), from mental emotion or hysteria, is most promptly remedied by the administration of Hoffman's anodyne. Mild attacks of *angina pectoris*, and of *spasmodic asthma*, may sometimes be aborted by a full dose of the ethereal preparations. The subcutaneous injection of *ether* is very effective in sudden cardiac depression.

Nervous or hysterical sick-headache is quickly cured by ʒ ss doses of spirit of ether. The most important application of these ethereal remedies is in the treatment of the *hysterical paroxysms*. As the action is prompt and quickly expended, it is obvious that ether or Hoffman's drops are only adapted to sudden hysterical seizures, and not to more lasting nervous symptoms arising in an hysterical constitution. Nothing can be more satisfactory than the prompt relief by these agents of *hysterical flatulence*, *globus hystericus*, and *hystero-epilepsy*. ℞ Spts. etheris composit., tinct. valerian. ammon., āā ℥ j. M. Sig.: *A teaspoonful in water every fifteen minutes until relieved.*

As a *cardiac stimulant in fevers*, the ethereal preparations are occasionally prescribed. For a quick effect, in an emergency of practice, they are useful, but are not equal to spirits and wine when a sustained effect is required.

Nitrous ether is employed in domestic practice as a mild *diaphoretic*, a *diuretic*, and *carminative*. It no longer occupies the place it formerly held in medical practice, but it is occasionally prescribed in *feverishness*, as a constituent in *expectorant mixtures*, in *combination with diuretic medicines*, etc.

Ether by the Hypodermatic Method.—Within the past few years, the subcutaneous injection of ether has taken an important position in therapeutics. It is necessary, therefore, to enter into this subject fully.

When ether is injected beneath the skin, more or less burning pain is felt at the point of insertion, and a puffy swelling is produced. In most subjects this swelling subsides in an hour or two, and no trace is left of the operation. In some instances, an induration, the size of a filbert, forms, and slowly disappears. Very rarely inflammation is set up about the site of the injection, and followed by suppuration, with more or less sloughing. If not too large an amount, suddenly and violently injected, is used, there will be no untoward results.

The effects of ether subcutaneously are the same in kind as, but more powerful in degree than, those produced by the stomachal administration. A local anæsthetic impression is made; in a few seconds, the action of the heart is powerfully increased, and soon the usual cerebral effects are manifest.

Ether was first employed subcutaneously by Dr. Comegys, of Cincinnati, in the treatment of *sciatica*. He injected from fifteen minims to a half-drachm, in the neighborhood of the affected nerve. This practice has been followed by others with success, and is now more or less widely used as a substitute for "the deep injection of chloroform." It is very desirable to have some exact observations which will determine the comparative value of these expedients.

The most important applications of ether, hypodermatically, are as a cardiac stimulant in the case of sudden and extreme depression of the heart, and as a general stimulant in adynamic states. In the depression caused by *hæmorrhage*, whether pulmonary or *post partum*, the injection of ether may obviate the necessity for transfusion. This practice is strongly urged by Peter, Féréol, and Mlle. Ocoumkoff, who report cases in confirmation. Remarkable results have been effected by the subcutaneous injection of ether in *adynamic pneumonia* (typhoid pneumonia), as practiced by M. Barth. Thus, of fourteen cases of severe type treated by these injections, eleven were cured. The quantity injected was about fifteen to twenty minims two, three, or four times a day, according to the degree of adynamia. The effects which follow almost immediately are these: the respiration becomes more easy, the pulse takes on more strength and volume, the tongue moistens, and the countenance assumes a better appearance. In from two to three minutes after the injection has been practiced, the odor of ether is recognizable in the breath (Barth).

In the eruptive fevers, especially in *variola*, the injections of ether have been used with admirable results (Castel). It is in a high degree probable that the same treatment will prove very useful in low forms of septic and inflammatory diseases in general. There can scarcely be any doubt that we have in this method a most useful addition to our therapeutical resources.

In place of ether, hydrobromic ether has been utilized in the treatment by the subcutaneous method of various spasmodic diseases, as *whooping-cough*, *chorea*, *asthma*, and similar affections.

Chloroformum.—Chloroform. *Chloroforme*, Fr.; *Chloroform*, Ger. A liquid containing at least 99 per cent by weight of absolute chloroform and not more than 1 per cent of alcohol. Its specific gravity should not be lower than 1·490. A heavy, clear, colorless, diffusive liquid, of a characteristic pleasant ethereal odor, a burning, sweet taste, and a neutral reaction. Soluble in about two hundred parts of water, and in all proportions in alcohol or ether; also in benzol, benzin, fixed or volatile oils.

If five cubic centimetres of purified chloroform be thoroughly agitated with ten cubic centimetres of distilled water, the latter, when separated, should not affect blue litmus-paper (absence of acids), nor test-solution of nitrate of silver (chloride), nor test-solution of iodide of potassium (free chlorine). If a portion be digested warm with solution of potassa, the latter should not become dark-colored (absence of aldehyde). If a few cubic centimetres be permitted to evaporate from blotting-paper, no foreign odor should be perceptible after the odor of chloroform ceases to be recognized. (U. S. P.)

When shaken with an equal volume of sulphuric acid, in a bottle closed by a glass stopper, and allowed to remain in contact twenty-four hours, no color is imparted to either. When one fluid drachm is evaporated spontaneously with one drop of a neutral, aqueous solution of litmus, the color of the latter is not reddened. The result of the test is the same if the chloroform contained in a white glass bottle has been previously exposed to direct sunlight for ten hours.

Emulsum Chloroformi.—Chloroform mixture. Purified chloroform, 40 c. c.; expressed oil of almond, 60 c. c.; tragacanth, 15 grm.; water, to make 1,000 c. c. M. Dose, a tea- to a tablespoonful.

Spiritus Chloroformi.—Spirit of chloroform. Purified chloroform, 60 c. c.; alcohol, 940 c. c. Dose, ʒ ss—ʒ j.

Aqua Chloroformi.—A saturated solution of chloroform in water. Dose, ʒ ss—℥ ss.

Antagonists and Incompatibles.—Chloroform separates from the mixture when prescribed with weak spirits or glycerin. It is soluble in alcohol (ten to six), in ether (one to seven), in water (one to two hundred). It dissolves very freely in olive-oil and turpentine, but does not dissolve in or mix with glycerin. It has very extensive solvent power, dissolving caoutchouc, gutta-percha, mastic, tolu, benzoin, copal, among the gums; iodine, bromine, the organic alkaloids; fixed and volatile oils, resins, and fats. In cases of poisoning by the int nal administration of chloroform, the treatment should be conducted on the same plan as for irritant poisons. There is no chemical antidote. To overcome its effects on the respiratory and circulatory systems, artificial respiration, cold affusion, and galvanism, may be employed.

Synergists.—Anæsthetic agents, opium, chloral, alcohol, etc., promote the action of chloroform.

Physiological Actions.—The taste of chloroform is hot, sweetish, and pungent. Undiluted it excites violent irritation and inflammation of the mucous membrane. In passing through the fauces the vapor may enter the larynx in such quantity as to cause great heat and inflammation, followed by œdema. In the stomach, chloroform produces a feeling of warmth, followed by coldness, like ether; but, when taken in large quantity undiluted, violent gastritis. Besides the local action, chloroform diffuses into the blood, and affects distant parts. Like alcohol and ether, it increases the action of the arterial system, and occasions excitement of the brain, followed by sopor. In lethal doses profound stupor and insensibility are produced by it.

Therapy.—A little chloroform (♏ ij—♏ v), dropped on sugar and swallowed, will remove some kinds of *nausea and vomiting*. It can be useful in non-inflammatory states only, as, for example, *sea-sickness*, the *vomiting of pregnancy*, *sick-headache*, etc. *Gastralgia* may sometimes be relieved in the same way. The following formula is an effective remedy for *flatulent colic:* ℞ Spirit. chloroformi, tinc. cardamomi comp., āā ℥ ij. M. Sig.: *A teaspoonful every half-hour in water.* Hepatic and saturnine colic are also benefited by chloroform, but the addition of opium increases its efficacy, and is usually necessary in these cases. Chloroform is a solvent of *biliary calculi*, and has been prescribed with the view to effect a solution of calculi contained in the gall-bladder, or lodged in the hepatic duct. It undoubtedly affords some relief, but not probably because of its solvent action. As has been remarked of ether, it is in the highest degree improbable that sufficient chloroform, even when it is administered in large doses, can reach the calculus to effect its solution, when experiments out of the body have shown that some hours are required to dissolve a calculus immersed in chloroform. In *irritable ulcer of the rectum*, and *itching about the anal region*, an ointment of chloroform gives great relief: ℞ Ung. zinci oxidi, ℥ j; chloroformi, ʒ j. M. Ft. ung. The vapor of chloroform may be applied directly to these parts.

In *hay-asthma*, *whooping-cough*, *spasmodic asthma*, *irritable reflex cough*, the vapor of chloroform may be used as follows: To a cup of warm water, 80° to 100° Fahr., add a teaspoonful of spiritus chloroformi, and repeat every five minutes. This inhalation should not be used except in the presence of a medical man, and not more than five teaspoonfuls should be inhaled at a time. The patient should inhale the vapors as they arise, directing them into the air-passages from the cup by a paper shield. A little chloroform (a minim or two) is a useful constituent of *expectorant mixtures*, when a neurotic element is present.

Chloroform is a very valuable hypnotic in *delirium tremens*. It is unsafe when used by inhalation in the treatment of this affection, but, by the stomach, not unfrequently excellent results are obtained from it. It is contraindicated when there are a vigorous action of the heart and an elevated state of the arterial tension, and useful when symptoms of depression and adynamia are present. It should be given in the form of the spirit. ℞ Spirit. chloroformi, tinct. capsici, āā ℥ j. M. Sig.: *A teaspoonful in water every half-hour, hour, or two hours.*

Neuralgia.—Chloroform is extremely valuable in the treatment of this disease, and it is the most effective when used by the method of "deep injection," first proposed by the author. This plan of treatment consists in the injection deeply, *in the neighborhood of the affected nerve*, of five to fifteen minims of pure chloroform. The official spirit of chloroform, ether, or even alcohol, may be used for this purpose. The first named, in the quantity of fifteen minims, is probably the best. Rarely does any local mischief result from these injections, except a temporary induration. The author has procured by this means apparently permanent relief to long-standing cases of neuralgic pain (tic-douloureux) affecting the superficial divisions of the fifth. Other practitioners have been equally successful, and the cases thus treated now include neuralgic affections of the most important nerves.

Pain in superficial nerves may sometimes be relieved by the local application of chloroform. ℞ Chloroformi, tinct. aconiti rad., āā ℥ ss; liniment. saponis, ℥ j. M. Sig.: *Liniment.* A piece of flannel, moistened with this, is applied to the painful part, evaporation being prevented by a covering of oiled silk.

An impending *paroxysm of intermittent* may be prevented by a full dose of chloroform (ʒ j—ʒ ij) administered before the onset of the chill. The inhalation of chloroform is used for the same purpose.

A few drops of chloroform, frequently repeated, is an excellent means of relief in *cholera*. It allays nausea and vomiting, arrests diarrhœa, relieves the cramps, and restores the temperature. It may be given in the form of spiritus chloroformi, or of chlorodyne, a very celebrated empirical remedy. No single remedy has been more efficacious than chlorodyne in the treatment of true cholera.

It has been stated lately that chloroform has a curative effect in tape-worm. The following formula has been successful: ℞ Chloroformi, ʒ j; crotoni olei, ♏ j; glycerini, ℥ j. M. Take as a draught. (Persh.)

Chloroform as a Counter-Irritant.—When chloroform is applied to the skin and evaporation prevented, it causes heat, redness, and even vesication. Frequently, chloroform is used locally to produce this effect, but usually in combination with other counter-irritants. ℞ Chloroformi, ol. terebinthinæ, āā ℥ j; lin. saponis, ℥ ij. M. Sig.: *Liniment.* ℞ Chloroformi, lin. camphoræ, āā ℥ j. M. Sig.: *Liniment.* These are elegant counter-irritant applications, in cases requiring the milder remedies of this class, and are used in various internal inflammations and local affections characterized by pain. Commercial chloroform can be used in preparing them.

Chlorodyne.—This empirical preparation is largely used in cholera, and in painful diseases requiring an anodyne. Numerous formulæ have been published, but none of them appear to possess the exact qualities of the original preparation by Dr. J. C. Browne. The dose of the genuine chlorodyne ranges from ten to thirty drops. The following formula makes a product more nearly resembling the original than any other known to the author:

Chloroform	4 ounces.
Ether	1 ounce.
Alcohol	4 ounces.
Treacle	4 ounces.
Extract of licorice	2½ ounces.
Muriate of morphine	8 grains.
Oil of peppermint	16 minims.
Sirup	17½ ounces.
Acid. hydrocyan. dil.	2 ounces.

Dissolve the muriate of morphine and the oil of peppermint in the alcohol, mix the chloroform and ether with this solution, dissolve the extract of licorice in the sirup, and add the treacle; shake these two solutions together, and add the hydrocyanic acid. Dose, five to fifteen minims.

Some of the published formulæ contain resin of cannabis Indica, atropine, perchloric acid, in addition to the ingredients above given.

Another chlorodyne, known as "Gilman's," has many advantages, and is now widely used. Its composition is as follows: ℞ Chloroformi purificati, ʒ ij; glycerini, ℥ ij; spts. vini rect., ℥ ij; acid. hydrocanic. dil., ʒ ij; tinct. capsici, ʒ ij; morphinæ muriatis, gr. viij; syrupi (treacle), ℥ iij. M. The dose of this chlorodyne for an adult is a *teaspoonful.* In prescribing the various mixtures known by the common name—*chlorodyne*—the strength should be ascertained before administering.

The following formulæ (Fox) are very efficacious in the local affections for which they are recommended:

℞ Chloroformi, ♏ vj; cucumber cerate, ℥ j. M. Sig.: *Ointment for pruritus.* ℞ Plumbi carbonat., ʒ ss; chloroformi, ♏ iv; ung. aquæ rosæ, ℥ j. M. Sig.: *Ointment for pruritus.* ℞ Chloroformi,

♏ viij ; glycerin., ʒ j ; ung. simplicis, ʒ vj ; potassii cyanidi, grs. iv. M. Sig.: *Ointment for pruritus.* ℞ Morphinæ acetat., 1 part ; chloroform, 8 parts ; lard, 60 parts ; oil of sweet almonds, 40 parts. M. An ointment to be applied several times a day in *pruritus pudendi.*

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ANÆSTHETICS AND ANÆSTHESIA.

Æther Fortior.—The stronger ether.

Chloroformum Purificatum.—Purified chloroform.

Neither of these anæsthetics should be used until its conformity to the standard of the United States Pharmacopœia has been ascertained. The tests of purity are given under their respective heads in the preceding article.

The term *anæsthetic*, proposed by Dr. Oliver Wendell Holmes, means an agent capable of producing *anæsthesia*, or insensibility to pain. It is true, *anæsthesia* is a term which, according to its etymological signification, should be applied to loss of sensation of touch, chiefly, and *analgesia* should be used to signify loss of the sense of pain ; but the word *anæsthesia*, as expressive of the state of profound unconsciousness induced by anæsthetics, is now so firmly established by usage that it were better to retain it. Insensibility to pain (analgesia) may be produced, without simultaneous loss of common sensation, touch (anæsthesia). By the inhalation of ether, chloroform, bichloride of methylene, nitrous oxide, and some other agents, the functions of animal life can be so far suspended that surgical operations involving intense pain, and certain natural processes, accompanied by great suffering, can be performed entirely without the consciousness of the subject concerned.

Physiological Actions.—When the vapor of ether or chloroform is inhaled, a sense of faucial irritation and of the need of air is experienced, and more or less cough is produced. The irritation of the fauces excites the flow of mucus, and the reflex act of swallowing. The feeling of need of air causes the patient to push aside the inhaler or sponge, and in children may lead to violent struggling. The sensibility of the glottis is soon diminished, the coughing ceases, and the inhalation then proceeds quietly.

The first effect is a general exhilaration, the pulse increases in frequency, the respirations become more rapid, and sometimes assume a sobbing or convulsive character; the face flushes; talking, laughing, crying, singing, and sometimes praying, indicate the cerebral intoxication. This stage of excitement varies in duration in different individuals, and is more pronounced in character and more persistent in those of mercurial disposition, and in the hysterical. At this period, although the patient can be easily aroused, sensibility to pain is decidedly diminished; although the sense of touch may be preserved, taste and smell are abolished, and the sight is either abnormally acute or is perverted by illusions. If the inhalation be continued, the patient passes into the condition of complete insensibility. In women and children, and males reduced by illness, the production of insensibility, if the anæsthetic be not inhaled too rapidly, takes place quietly; but, if the subject be a robust male, in full health, especially if the inhalation has been proceeded with rapidly, the stage of insensibility is preceded by a tetanic convulsive stage, in which the voluntary muscular system and the respiratory muscles become rigid, the breathing stertorous, the face cyanosed. This condition of rigidity is similar to, if not identical with, the tetanic stage of the epileptic paroxysm. If the inhalation of the anæsthetic be pushed still further, the tetanic rigidity subsides, the cyanosis disappears, the breathing proceeds quietly, and a condition of complete muscular relaxation, and of abolition of reflex movements, is established. When this is accomplished, the arm drops without resistance when let fall, the conjunctiva is insensible to irritation, the pupils do not alter in size when exposed to light, and no mechanical irritation awakens the least consciousness of pain. The surface is cool, and bathed with abundant perspiration, the countenance is placid, the eyes closed, the pupils rather contracted than dilated; the respiration easy, but more shallow than normal; the pulse slower—it may be feebler, it may be stronger than in health. The functions of the cerebrum are suspended; only the lower centers, presiding over respiration and circulation, continue in action. Out of this condition, and without interference, the patient will presently emerge. If, however, the inhalation be continued, these organic functions will be suspended, and life will be terminated by the cessation of the action of the heart and of the respiratory organs.

There are several modes of dying from anæsthetic vapors:

1. By the first mode, the death is sudden and occurs very soon after the inhalation has begun, and is ascribed to "irritation of the peripheral nervous system, accumulation of carbonic acid in the blood, and arrest of the action of the heart." This explanation, the author submits with diffidence, seems very unsatisfactory, for phenomena of this kind, up to the point of cardiac paralysis, must ensue in all cases of chloroform narcosis. The sudden death, at the beginning of inha-

lation, seems to be more properly explicable on the theory that the first chloroform vapor which reaches them paralyzes the cardiac ganglia, already in an abnormal state of susceptibility from causes not now understood, for this accident sometimes occurs in persons who have previously taken the anæsthetic without unfavorable symptoms of any kind.

2. By the second mode, called by Richardson *epileptiform syncope*, death ensues in the stage of rigidity preceding complete muscular relaxation, and is due to tetanic fixation of the respiratory muscles, and consequent interference with the pulmonary circulation, accumulation of blood on the venous side, and arrest of the heart's action. In these cases respiration ceases before the pulsations of the heart cease.

3. *By paralysis of the respiratory muscles.* Death ensues during the stage of complete muscular relaxation, and the action of the heart continues for some seconds, or even minutes, after respiration has ceased.

4. *By paralysis of the heart.* This also occurs in the course of complete insensibility; the motor ganglia are paralyzed, and the heart suddenly ceases to act, the respiration continuing for a short time longer.

5. This mode of dying is made up of two factors: *depression of the functions* by chloroform narcosis, and the shock of the accident, or the surgical operation. Death may ensue during the inhalation, or may occur afterward.

CONDITIONS OF THE ORGANISM RENDERING THE USE OF ANÆSTHETICS DANGEROUS.—Experience has demonstrated that old drunkards are peculiarly unfavorable subjects. When tumor or abscess of the brain exists, it is dangerous to administer anæsthetics. Instances of sudden death under these circumstances are relatively numerous. Very much enlarged tonsils, swollen epiglottis, œdema of the glottis, are contraindications, but not insuperable, to the use of anæsthetics. Emphysema of the lungs is so frequently accompanied by ischæmia of the arterial, and engorgement of the venous side of the systemic circulation, and with dilatation of the right cavities, that it must be considered a dangerous state in which to administer chloroform, or even ether. Fatty change in the muscular substance of the heart must be considered peculiarly unfavorable, for more deaths have ensued from this cause than any other.

Chloroform and ether have been administered with safety in cases of phthisis and heart-disease (valvular lesions), the muscular substance and its contained ganglia being free from structural change.

Experience has abundantly demonstrated that those reduced by illness and disease, and the feeble, bear anæsthetics better than the healthy and robust; that children and women are better subjects than adults and men; that anæsthetics are safer when given for operations for disease than for injury.

Incomplete anæsthesia is a condition of danger. Numerous accidents have occurred from the use of anæsthetics for trivial operations —notably for extraction of teeth—in which but a partial degree of insensibility is induced. In such cases the heart, enfeebled by chloroform narcosis, is suddenly paralyzed by the reflex action proceeding from the peripheral injury. The district of tissue supplied by the fifth nerve is an especially dangerous region, owing doubtless to the intimate connection of the nucleus of the fifth with the nucleus of the pneumogastric. By far the largest number of fatal cases have resulted from a neglect of this rule: it is never safe to proceed in a surgical operation with anæsthetics, unless complete insensibility has been produced. The author is aware that Trousseau and Pidoux have attributed the number of cases of fatal chloroform narcosis, which have occurred in England, to the fact that the just-mentioned rule is adhered to by English surgeons. Their words are as follows: "*En Angleterre, les chirurgiens portent l'éthérisation jusqu'à l'abolition de toutes les facultés animales, jusqu'au commencement de la période d'éthérisme organique. Plus prudents sous ce rapport que leurs confrères de la Grande-Bretagne, les chirurgiens français ont l'habitude de s'arrêter dès que la sensibilité aux excitations de la peau est abolie et que la résolution musculaire commence. Cette prudence explique comment les chirurgiens français ont éprouvé moins d'accidents graves et compté moins de morts subites.*" (Vol. ii, p. 322.)

Modes of conducting the Inhalation.—After ascertaining that none of the contraindications mentioned above exist, the patient may be prepared for the inhalation of the anæsthetic vapor. The inhalation should not be proceeded with soon after a full meal. Vomiting, as the narcosis subsides, is usual, and, as the insensibility of the glottis persists for some time afterward, particles of food may be lodged in the chink, causing fatal suffocation. Several cases of this kind have been reported. On the other hand, it is bad practice to administer an anæsthetic after a prolonged period of fasting, for the exhaustion thereby induced may be an influential factor in determining a fatal result. Before the inhalation is begun, it is proper to administer an ounce or two of whisky or brandy. Much more important is the expedient proposed by Bernard and afterward by Nussbaum, to premise a subcutaneous injection of morphine. Bernard proposed to administer the morphine before beginning the inhalation; whereas Nussbaum used it after unconsciousness to pain had been produced. The advantages of the former method are obvious. When the morphine influence takes place, the inhalation will proceed quietly without the struggling and coughing, and spasmodic breathing, which so interfere with the administration of anæsthetics, especially of ether. The use of morphine subcutaneously also lessens materially, if not prevents entirely, the stage of rigidity and spasm. The quantity of the anæsthetic required is much less, and the stage of insensibility more prolonged, when morphine is thus given.

Besides the foregoing conspicuous advantages derived from the preliminary subcutaneous injection of morphine, there can be no doubt that this agent antagonizes the paralyzing action of the anæsthetic on the cardiac and respiratory centers, and prevents the subsequent shock due to the administration of the anæsthetic and the performance of a surgical operation.

The proposal of Bernard, as subsequently advocated by Nussbaum, was some time afterward strongly urged by the late Prof. William Warren Greene, M. D., of Pittsfield, Massachusetts, and Dr. J. C. Reeve, of Dayton, Ohio. Soon after the publication of Bernard's observations, the author, in his "Manual of Hypodermatic Medication," proposed the use of morphine and atropine combined as more perfectly realizing the object contemplated. Since this time, at Lyons, the combination of morphine and atropine has been largely employed preliminary to ether inhalation. The method is known as "*anesthésies mixtes*," or, anæsthesia by a mixed method (Aubert). The addition of atropine is to increase the forces of the antagonism against the depression of the cardiac and respiratory functions. The experience of the Lyons school is decidedly in favor of the method of mixed anæsthesia. Adverse reports from other quarters, however, have not been wanting, but the relevancy of their facts is doubtful.

When the anæsthetic is about to be administered, the operator should, by a cheerful and confident manner, remove the fears of the patient.. None of the *parapherna* of the operation to be performed should be exhibited before the patient, and no remarks should be made in his hearing regarding his case, the anæsthetic sleep, or the surgical procedure. Only the physician having the administration of the anæsthetic in charge, and the necessary assistants, should be present in the apartment. An abundant supply of fresh air should be insured to the patient, and all the appliances required for resuscitation should be at hand, but not ostentatiously paraded before the patient.

The simplest apparatus only is required. Complicated inhalers have, as frequently as the towel or the handkerchief, been used in fatal cases of chloroform narcosis. A cone of stiff paper, lined with lint or felt, and large enough to cover the nose and mouth of the patient, is the best form of inhaler for the administration of ether. Lente's ether-inhaler consists of a cone of hard rubber lined with felt, and having attached to the apex a flexible rubber tube communicating with the ether-bottle. This is a very satisfactory apparatus. A similar but much less complicated and expensive inhaler is that of Dr. Allis, of Philadelphia. The utility and desirableness of this apparatus are much commended by Prof. William Goodell. When ether is inhaled, the atmosphere is, as far as possible, excluded, in order that the anæsthetic effect may be quickly induced. *The important point in the administration of chloroform is to secure such an admixture of atmospheric air as that the amount of chloroform-vapor shall not exceed three and a half per cent.* If this rule be regarded, the form of inhaler is of little importance. The original method of Simpson consisted in applying the vapor by dropping slowly chloroform on a piece of thin cloth laid over the mouth and nose, or by a linen handkerchief moistened with half a drachm. The mouth and nose should be protected from the irritant action of the chloroform by inunction with oil.

A cone made of a towel, having a large opening at the apex, and containing a suitable, very porous sponge, is now probably more employed than any other form of inhaler for giving chloroform. The typical method for administering it is that of Snow: in a bag of suitable size the vapor of chloroform is mixed with air in the proper proportion, and then given directly; but, obviously, such an arrangement is not often available.

In administering the vapor of chloroform by any of the modes in use, it should not be forgotten that it has a density and weight four times those of air, and that, consequently, when a cloth or handkerchief is held closely over the mouth, the air is displaced, and the patient may be breathing little more than chloroform-vapor. During the administration of ether, attention should be directed to the state of the respiration, for arrest of the respiratory movements is the only source of danger. When chloroform is being inhaled, the state of the circulation, as well as of the respiratory apparatus, must be regarded.

MEANS OF REMOVING DANGEROUS SYMPTOMS.—Suspension of the heart's action is to be met at once by the withdrawal of the vapor, and the inversion of the patient, according to the method of Nélaton; failure of respiration, by forcibly drawing out the tongue, by the practice of artificial respiration, and by faradization of the respiratory muscles. Artificial warmth should be applied, and cooling of the body by cold-water douche, etc., should be prohibited. Acupuncture of the heart, galvano-puncture, injection of ammonia into the veins, are measures which have been used in extreme cases, but unfortunately rarely with success. Amyl nitrite, by inhalation or subcutaneously, has proved very useful in some cases. Schirmer arouses patients by irritating the nasal mucous membrane by means of a roll of paper of suitable size, and this may be made more exciting by dipping the end in aqua ammonia. Alcoholic stimulants—whisky or brandy—have often been used hypodermatically with asserted advantage. At the present time the subcutaneous injection of ether is the popular expedient. It is, however, very questionable whether the administration of alcohol or one of its derivatives can be useful in a condition of things brought about by an anæsthetic of alcoholic origin. The author believes, indeed, that serious mischief is done by this practice in cases capable of resuscitation.

In practicing resuscitation for arrest of breathing due to ether, artificial respiration by the method of Silvester, faradization of the chest-muscles, and inversion of the body by the method of Nélaton, are the most promising expedients.

THERAPY.—Anæsthetic agents are used to quiet pain and spasm from disease, to render the dressing of injuries and surgical operations painless, and to produce muscular relaxation. Ether-inhalations give entire relief to the pain of *neuralgia* (*tic-douloureux*), *cancer*, and *inflammation;* to pain dependent on spasms—*tetanus*, *chorea*, *hepatic* and *nephritic colic*, etc. It is not necessary in these cases, as a rule, to induce full anæsthesia, for, as has already been pointed out, the sensibility to pain ceases before the condition of insensibility is reached —before, indeed, the perceptive centers of conscious impressions are otherwise impaired than as to the appreciation of pain. Paroxysms of *maniacal delirium*, and of *puerperal mania*, when violent and uncontrollable, are sometimes quickly quieted and refreshing sleep obtained, from which the patient eventually arouses in a calmer frame of mind. Ether is the proper agent for this purpose. It should not be forgotten that *anæsthetics are dangerous in delirium tremens.*

In *puerperal convulsions due to reflex irritation*, or to *uræmia*, the use of chloroform is invaluable. It is equally effective in the *reflex convulsions of early life*, in the *uræmic convulsions of scarlet fever*, and in the so-called *hystero-epilepsy*. When puerperal or other forms of convulsive seizures are due to cerebral hæmorrhage, no good can be accomplished by anæsthetic inhalations. In any case, although convulsions may be arrested by anæsthetic inhalations, other appropriate measures must be resorted to for the permanent removal of the causes. A *paroxysm of epilepsy* impending may be aborted by the inhalation of ether, but the nitrite of amyl is a more effective remedy for this purpose.

In certain *neuroses of the respiratory organs*, great relief is obtained by anæsthetic inhalations. *Laryngismus stridulus* may be quickly cured by the vapor of chloroform. A few drops of chloroform on a handkerchief will suffice, and special care should be taken to dilute the vapor largely with air. A similar procedure will relieve severe paroxysms of *whooping-cough*, but a more energetic use of chloroform is required when *convulsions* occur during a fit of coughing. No single agent gives more relief in *asthma*, but, like all other remedies for this disease, the power of relief declines, and increasing doses of the anæsthetic become necessary, so that the habit of chloroform or ether narcosis is formed.

Anæsthetic inhalations should not be recommended in cases which *will probably require their use for a long time*, because the inclination for this kind of intoxication grows rapidly, and is as difficult to control as the opium-habit. The author has seen one case in which the patient consumed a pound of chloroform daily, but, as might be expected, this extraordinary consumption of the anæsthetic did not long continue, for the patient succumbed in a few months.

In *obstetric practice* the applications of anæsthetics are numerous and important. The indications and contraindications for chloroform in *natural labor* may be formularized as follows: When the labor is of short duration, and not excessively painful, anæsthetics should not be used; on the other hand, when the labor is protracted and the suffering great, they favor the progress of the case and prevent exhaustion and uterine inertia. In *primipara* caution is necessary. The inhalation of the anæsthetic should not begin until near the close of the first stage, unless those painful but ineffectual contractions occur which have been aptly characterized as "nagging pains," when the vapor, very much diluted, may be cautiously inhaled for their relief. The inhalation should be practiced only during the existence of the pain. The influence of the anæsthetic on the pulse, respiration, and uterine contractions, should be carefully observed, and, if the pulse fail, the respirations become shallow, or the pains lose in efficiency, the inhalation should be discontinued. If the anæsthetic cause great excitement, and the patient become loudly clamorous for more, while the uterine contractions are lessening in force, it is doing harm and should be withdrawn. It is never necessary, nor proper, to administer the anæsthetic to complete unconsciousness. Toward the close of the second stage, when the head begins to distend the external parts, the quantity of chloroform may be somewhat increased, but the inhalation should be discontinued when the occiput has passed under the pubic arch. If these rules are followed, the action of the anæsthetic is beneficent. Properly administered, the use of chloroform may be considered perfectly safe in the parturient female. It is generally conceded that no well-authenticated case of death from the use of chloroform in labor has occurred, when the administration was in the hands of a properly-qualified medical man.

The following evil results, the author believes, have followed the incautious use of anæsthetics in labor: the progress of the case arrested, so that forceps became necessary; slow and imperfect uterine contractions, and consequent *post-partum* hæmorrhage; a toxic condition of the mother's blood, with after-excitement, wakefulness, and puerperal mania; asphyxia of the child, tedious convalescence, and subinvolution of the womb.

When *instrumental delivery* is required, the utility of anæsthetics is unquestionably great. It facilitates the necessary manipulations, and prevents shock. The inhalation should be carried far enough in these cases to produce sufficient quietude in the patient, and it may be to complete muscular resolution. When *turning* is to be performed, the state of chloroform narcosis must be deep enough to suspend uterine contractions.

If *puerperal convulsions* occur at any stage, the utility of chloroform is unquestionable. The limits of its utility in these cases have already been indicated.

When careful examination of the pelvic viscera is to be made to establish the diagnosis in difficult and obscure cases, as, for example, *phantom tumor*, *ovarian and fibroid growths*, *pelvic abscess*, etc., the importance of full anæsthesia can hardly be over-estimated.

The use of anæsthetics in *operative surgery* is now an indispensable practice. It may be compendiously stated that ether, or chloroform, is required in all *surgical operations of magnitude*, for the *reduction of dislocations*, for the *taxis in strangulated hernia*, for *dressing painful wounds* and *adjusting fractures*, for *breaking up adhesions*, and *contractions of muscles* and *tendons in cases of deformity*, for *establishing the diagnosis in feigned diseases*, etc.

The after nausea and vomiting, which are sometimes most depressing, and occasionally dangerous, produced by anæsthetics, may be prevented by the hypodermatic injection of morphine and atropine before beginning the administration of the anæsthetic. After the patient emerges from the anæsthetic sleep, the above-mentioned unpleasant after-effects may be relieved by a minute quantity of morphine ($\frac{1}{12}$ of a grain) and atropine ($\frac{1}{125}$ of a grain) injected subcutaneously.

Comparative Utility of Ether and Chloroform.—Chloroform is more pleasant to inhale, and is less irritant to the air-passages than ether. The vapor of chloroform is not, and the vapor of ether is, inflammable, whence it follows that the former may be alone admissible at night under some circumstances. The stage of excitement is longer from ether than from chloroform, but, as ether may be given much more rapidly, this difference in action may be made to disappear in practice. Chloroform is more prompt in its effects, and the narcosis induced by it more sustained, than is the case with ether; but these advantages possessed by chloroform are quite balanced by the greater freedom with which ether may be administered. The danger from the inhalation of chloroform is vastly greater than from ether.

It follows from the above considerations that ether should be used in preference to chloroform in all cases, except during labor. Chloroform is to be preferred in labor, because more pleasant to inhale, more prompt in action, and without inflammability. The consideration of safety must necessarily take precedence, but experience has shown that chloroform is perfectly safe in labor when properly administered.

The frequency with which fatal cases of chloroform narcosis have been reported—amounting in the aggregate now to about five hundred—imposes an immense responsibility on the administrator. In the present state of opinion on the subject, the use of chloroform, when ether is available, for the production of anæsthesia, can hardly be justified, especially if a fatal result follow its administration.

Ethyl Bromide.—The physical properties of this ether are mentioned on another page in connection with ether. As an anæsthetic, it was first known to Mr. Nunnely, of Leeds, and he first employed it in surgical practice in 1865. Dr. Turnbull gave an account of its properties, based on experimental and clinical evidence, in 1877, but the most extended trials of its anæsthetic powers were made by Dr. Levis, of Philadelphia, in 1879–'80. In the latter year two unsuccessful cases occurred, one in the hands of Dr. Levis, its chief promoter, and the other in the practice of Dr. Marion Sims, of New York. These fatal cases, and some crude physiological experiments, undertaken to prove that ethyl bromide is a heart-paralyzer, started a reaction against this anæsthetic, then beginning a promising career, and in a short time it fell into almost complete disuse. It has, however, valuable properties which should preserve it from neglect. To induce complete insensibility, from four to six grammes (ʒ j—ʒ jss) must be administered rapidly. The odor is not unpleasant, and but little irritation of the air-passages is produced. If administered in full quantity, there is a very brief (scarcely noticeable) stage of excitement, and the period of rigidity is very short and not pronounced. The face is flushed, the ears red, the eyes injected, and the pupils are more or less dilated. The action of the heart is accelerated, and the pulse increases in force. The respiration is also somewhat quickened, and in some subjects becomes snorting or stertorous, but irregularity or arrest of the respiratory movements has not occurred. More or less embarrassment of breathing has been occasionally caused by an accumulation of bronchial mucus. It does not often induce nausea and vomiting; but women are more apt to be disturbed in this way than men. The duration of the stage of insensibility is brief and the awakening prompt, with little of the confusion of mind and excitement characteristic of ether and chloroform. As a rule, the patient wakes out of the anæsthetic condition with little distress of any kind.

In the fatal cases recorded, there are strong doubts in regard to the share of ethyl bromide in the result. In Dr. Levis's case the patient was far advanced in pulmonary disease, and was unfit for the administration of any anæsthetic. In Dr. Sims's case the death of the patient occurred a number of hours after the operation, which was a tedious one, requiring very protracted use of the anæsthetic. It is said that a strong odor of bromine pervaded the entire body of this subject. It is, however, in a high degree improbable that decomposition of the ethyl bromide takes place when it is inhaled.

In administering this anæsthetic the method pursued with ether is best. If given promptly, in sufficient quantity, and but slightly diluted with air, the stage of insensibility can be induced in about five minutes (Levis). It is not suited to operations requiring much time. It is, however, peculiarly well adapted for slight or brief operations of a very painful character, and for ophthalmic practice it is unequaled, according to Chisolm.

M. Périer states that he has used ethyl bromide very often as a local anæsthetic, instead of ether, and, he affirms, with great success. The method to which he refers is local anæsthesia as inaugurated by Richardson with the spray-douche. Among other distinct advantages over ether, ethyl bromide is not inflammable, and can consequently be used under circumstances prohibiting the former.

The inhalation of ethyl bromide has been utilized in the treatment of diseases for the relief of which the bromides have been given by the stomach. MM. Bourneville and Ollier have carefully investigated this action of ethyl bromide in *hysteria* and *epilepsy*. They find that hysterical seizures are promptly arrested, and that in epilepsy the daily administration of this remedy during a period of two or three months notably diminishes the frequency of the attacks. This practice might be advantageously extended to the treatment of severe *chorea*, *whooping-cough*, *spasmodic asthma*, *hepatic and renal colic*, etc. For these purposes, only sufficient ethyl bromide is inhaled to relieve the pain or spasm, or to induce sopor.

Bichloride of Methylene.—This agent, similar to chloroform, was first proposed as an anæsthetic by Dr. B. W. Richardson. It is more agreeable to inhale, and less apt to produce after-sickness, than chloroform, but it is not less, and probably more, dangerous to life. Five or six deaths have occurred in the cases in which methylene bichloride was administered. Spencer Wells has constantly used it since it was introduced, without a single untoward result. But he employs a special administrator, and gives the vapor with a regulated supply of air. His apparatus consists of a mask closely fitting over the mouth and nose, connected by a flexible tube with a bottle containing the anæsthetic, and with a rubber hand-ball, which sends into the mask, with every contraction of the bulb by the hand, this quantity of air with the anæsthetic vapor. As no accidents have happened, and yet patients are kept narcotized for hours at a time, there can be no doubt of the security afforded by this method of conducting the inhalation. It were well if this plan were applied to the inhalation of chloroform as well as bichloride of methylene.

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Local Anæsthesia.—The diminution of the cutaneous sensibility, by the application of ice and freezing mixtures, has long been practiced. It was not, however, until Richardson's method by the hand-ball spray apparatus had been proposed, that there had been much use made of local anæsthesia.

This method consists in directing a current of atomized ether against the part to be anæsthetized. The ether employed for this purpose should have a specific gravity not to exceed 0·723. Rhigolene, the lightest liquid known, a product of the fractional distillation of petroleum, is more effective than ether, but great difficulty attends its use, owing to its extreme volatility. When a current of atomized ether or rhigolene is directed against the skin, the rapid evaporation produces an intense degree of cold, in consequence of which the nerves lose their power of transmitting impressions to the sensorium.

A serious drawback to the process of producing local anæsthesia is the unpleasant burning which follows in the part when it recovers from the freezing, and also the great pain which attends the application of ether-spray to certain parts.

THERAPY.—For small operations, such as *extraction of teeth and opening abscesses*, the method of local anæsthesia is extremely useful. It has been and can be used with entire success in much larger operations, but it is generally employed for merely minor ones.

The application of ether-spray to the spine is an extremely serviceable remedy in *spinal irritation* and in *chorea*. In the latter disease it alone suffices to effect a cure. In *neuralgia* of superficial nerves, *lumbago*, *muscular rheumatism*, etc., the ether-spray affords relief very quickly, which may be permanent.

INFILTRATION ANÆSTHESIA.—*Schleich's method* consists in the injection into the substance of the skin of a solution of the alkaloids having anæsthetic property. The pressure exerted by the fluid is augmented by the œdema which ensues; hence it is known as "infiltration anæsthesia." Besides the local action of the anodyne, and the pressure on the nerve endings, absorption takes place, and a systemic impression adds to the local effect. The infiltration area is quite insensitive, and is marked by an urticaria-like eruption. The local anæsthesia lasts about twenty minutes, but the systemic effects continue during the usual time of a hypodermatic injection. The anæsthetic area can be extended in any direction, by successive injections. The strength of the solution may vary with the indications and the character of the tissue injected. Schleich employed three solutions containing cocaine, morphine, and common salt, as follows:

No. 1.

℞ Cocaine hydrochlor.	·2 = (gr. 3) approx.;
Morphine hydrochlor.	·025 = (gr. ⅓) approx.;
Sodii chlorid.	·2 = (gr. 3) approx.;
Aquæ destillat. et steril.	ad 100 = f ℥ iv.

Add 2 drops of a 5-per-cent solution of carbolic acid.

No. 2.

℞ Cocaine hydrochlor.	·1 = (gr. 1½) approx.;
Morphine hydrochlor	·025 = (gr. ⅓) approx.;
Sodii chlorid.	·2 = (gr. 3) approx.;
Aquæ destil. et steril.	ad 100 (f ℥ iv).

Add 2 drops of a 5 per-cent solution of carbolic acid.

The Schleich solution No. 3 has been found too dilute to have any decided effect, and is not any longer used on this side of the Atlantic. In fact, while the method is still used, surgeons do not restrict themselves to any specified formula. The main point is mixed anæsthesia, or infiltration anæsthesia, and the adaptation of this principle to comparatively weak solutions of the anodyne.

Solution No. 1 is intended to be used where the skin is inflamed or is highly sensitive. No. 2 is intended for ordinary conditions, and a very weak solution is used when extensive tracts of the skin are to be rendered insensitive by successive injections, whereby the danger of toxic effects is enhanced.

Eucaine has been proposed as a substitute for cocaine in this infiltration method. It is less depressing on the circulation and is less toxic, and the anæsthetic area is greater and the effect more persistent. Braun, however, in a recent elaborate investigation has shown that eucaine is distinctly inferior to cocaine for the purpose of local or infiltration anæsthesia. In comparing the various agents employed in this mode of anæsthesia, Braun found that the order of efficiency was first, cocaine, second, eucaine "B," third, eucaine "A." His final statement was that cocaine and eucaine "B" are the only substances to be employed in this way; that they alone cause local sensory paralysis without injury to the tissues. As respects the power of cocaine to lessen the sensibility of parts, the weakest solution having anæsthetic effect was recently ascertained to be 1 in 20,000, or, approximately, one grain of the hydrochlorate to two pints of distilled water.

The salt of eucaine usually employed is the hydrochlorate. This for internal administration may be given in solution, pill, or capsule, in doses corresponding with those of cocaine, over which it has the advantage that it has no toxic effects, causes no cardiac depression, and no nausea or vomiting. For ordinary purposes it may be applied topically in a 3-per-cent solution, in ophthalmic, nasal, or faucial affections, and in various minor surgical operations. Indeed, according to Schleich, eucaine may be substituted for cocaine in all of the applications made by the infiltration method, as in other respects.

Eucaine, "A" and "B."—Eucainæ hydrochlorat. Eucaine is a modified cocaine, possessed of similar anodyne property, but without some ill effects that render cocaine undesirable. Eucaine "A" (alpha) is a benzoylamethylester in which for the ecgonin of cocaine is substituted another piperidine derivative. Among its advantages over cocaine are that it is less poisonous and is less injured by hot water, and has fewer after effects. Of the two eucaines, it is asserted that eucaine "B" is more soluble, less irritating, and possessed of equal anæsthetic property. It is preferred, therefore, for the production of local anæsthesia by Schleich's method. By Heinze it is advised that it should be administered in salt solution without morphine, according to the following formula :

Eucaine "B"	·1 (1·5 grs. approx.)
Sodium chloride	·8 (12 approx.)
Distilled water	ad 100· (f℥iv approx.)

Nitrous Oxide.—Protoxide of nitrogen. Laughing-gas.

Composition and Properties.—A colorless, inodorous gas, having a slightly sweetish taste, and a specific gravity of 1·527. It consists of one equivalent each of nitrogen and oxygen. It increases the rate of combustion of inflammable substances. Water at ordinary temperature absorbs about three fourths of its bulk of the gas. By pressure and cold the gas may be condensed into a liquid, and can then be stored up in suitable vessels for transportation and use. The quantity of the gas taken up by cold water may be much increased by pressure, and the water will then yield it up on heating. Hence this constitutes a convenient mode of storing the gas for preservation. The ordinary mode of storing the gas is in gas-bags holding about eight gallons, in gasometers, or in the liquid form in strong metallic casks.

Physiological Actions.—The first surgical operation performed with a modern anæsthetic was the extraction of a tooth, the subject being unconscious from the inhalation of nitrous oxide. It had long been known that this gas produced decided exhilaration when inhaled to a certain point. It has a very short anæsthetic stage, unless the inhalation of the gas be continued.

The first effect of the inhalation of nitrous oxide is a subjective dizziness, whirring noises in the ears, and tingling and loss of sensation throughout the body. Extraordinary illusions beguile the senses, and the intoxicated subject suddenly breaks forth into singing, declamation, sobbing, melancholy, or manifests a pugnacious tendency and assaults those about him. As the effects quickly cease, and as the return to consciousness is very abrupt, the subject is surprised and ashamed to find himself in some ridiculous or *grandiose* position quite foreign to his usual demeanor.

When used to produce anæsthesia for surgical operations, the inhalation of the gas is forced, and the stage of excitement is very brief. The countenance assumes a frightful aspect, most alarming to those who have not witnessed the inhalation of the gas. The face becomes deadly pale, the respirations, at first shallow, soon assume a stertorous character, the jaw becomes fixed, the eyes protrude, and the pallor of the face is presently replaced by a bluish and purplish tint.

So far as the exterior phenomena can afford any indication of the nature of the action, the condition produced by nitrous oxide is an asphyxiated state. The blood ceases to be oxygenated, carbonic acid accumulates, and the centers of conscious impressions are rendered inactive in consequence of the deficient supply of oxygen and the excess of carbonic acid. The rational indications of the nature of the narcosis produced by nitrous oxide are confirmed by physiological experiment. It has been found that the exhalation of carbonic acid is decidedly diminished by the inhalation of nitrous oxide, and that animals live no longer in an atmosphere of this gas than in an atmosphere of nitrogen.

The inhalation of nitrous oxide appears to be almost free from danger, and it is rare that unpleasant after-effects follow its administration. Four fatal cases have certainly occurred, which can with propriety be attributed to the lethal action of this gas, and various cases have fallen under the observation of the author in which nervousness, vague mental symptoms, and headache, have been experienced after the inhalations.

THERAPY. The very prompt action of nitrous oxide and the quick subsidence of the narcosis render it a very useful anæsthetic agent when small operations, quickly executed, are to be performed. It is especially adapted for the *extraction of teeth, opening of abscesses,* and *similar minor operations.* But it has also been used successfully for maintaining prolonged anæsthesia for the *performance of capital operations.* There is no difficulty in keeping up insensibility from fifteen minutes to a half hour, since the introduction of liquefied gas and of apparatus for its suitable application.

It has been asserted that *diabetes mellitus* may be caused by its administration, but the evidence is far from satisfactory. That albuminuria may be induced thereby has also been alleged, but the evidence for this is still less conclusive. What danger soever arises in the course of its administration is due to the nature of its physiological actions, and can occur only in such subjects as have rigid arteries, or atheromatous degeneration, which may result from premature or actual old age. The blood pressure rises during the inhalation of the gas, and the venous stasis occurring, any vessel far advanced in the calcareous and fatty change may yield to the increased pressure and cerebral hæmorrhage result. Some cases of apoplexy apparently thus induced have been reported. Ordinarily, should any threatening symptom arise during the administration of the gas, it is only necessary to withdraw the gas and apply artificial respiration.

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Chloral.—Chloral. Hydrate of chloral. *Chloral*, Fr.; *Chloralhydrat*, Ger.

Separate, rhomboidal, colorless and transparent crystals, slowly evaporating when exposed to the air, having an aromatic, penetrating, and slightly acrid odor, a bitterish, caustic taste, and a neutral reaction. Freely soluble in water, alcohol, or ether; also soluble in four parts of chloroform, in glycerin, benzol, benzin, disulphide of carbon, fixed or volatile oils. It liquefies when mixed with carbolic acid and camphor.

Dose, grs. v—℈j, or more, but it should not be forgotten that ʒ ss has produced toxic symptoms.

Antagonists and Incompatibles.—The depression of the heart and respiration caused by chloral is antagonized by alcoholic stimulants, ammonia, atropine, by galvanism, and by artificial heat. These are, therefore, appropriate remedies to be employed in cases of poisoning. Strychnine is held by Liebreich to be antagonistic, and hence it may be administered hypodermatically when the measures above mentioned are being used.

Alkalies decompose chloral with the production of formic acid and chloroform, hence all agents having an alkaline reaction are incompatible.

Synergists.—The hypnotic medicines, notably opium, and the anæsthetics, deepen the effects of chloral when they are simultaneously administered.

Physiological Actions.—Chloral has considerable antiseptic property, and is preservative of animal textures. It produces redness and inflammation of the skin, when kept in contact with it for a lengthened period. The taste of chloral is hot and pungent, and it excites an abundant flow of saliva. In the stomach it causes first a cooling sensation, followed by warmth, and when taken in large quantity may set up a high degree of gastric irritation, nausea, and vomiting. In moderate quantity chloral rather stimulates than impairs the appetite, and indigestion and nausea do not, as a rule, follow as an after-effect.

Chloral diffuses into the blood rapidly. The changes which occur after its entrance into the vessels are much disputed. Liebreich, as is well known, was led—by observing the reaction when chloral is brought into the presence of an alkali—to the deduction that the soda of the blood would split up chloral into chloroform and formic acid, and that, therefore, the effects belonging to chloroform might be produced by the administration of chloral. It is probably true that this reaction does take place to some extent, but there are several insuperable objections to the theory of Liebreich:

1. The effects of chloral differ from those produced by a corresponding quantity of chloroform.

2. After the administration of chloral, there is no elimination of chloroform by the breath or urine.

3. Chloral is more decidedly hypnotic, and much less anæsthetic, than chloroform.

4. Crystals of chloral have been recognized in the blood, and the products of the decomposition of chloral have recently been recovered from the urine.

The effects which follow an ordinary medicinal dose (fifteen to thirty grains) are not the same in all subjects, although it must be admitted that a great degree of uniformity exists. When there is present an insusceptibility to its hypnotic action it produces headache, and in some subjects a delirious excitement. Immediately preceding its hypnotic action there is developed in all subjects a stage of excitement, usually very short in duration, and followed by sudden and complete sopor. The sleep produced by chloral is extraordinarily like natural sleep, and is calm, dreamless, and refreshing. It is not a condition of narcotism, and the patient may be easily aroused to take food and nourishment, and will quickly and without difficulty fall asleep again. As a rule no unpleasant after-effects are experienced from a dose of chloral—no headache, faintness, giddiness, nausea, and constipation, so common after morphine. The quantity of chloral necessary to produce sleep, without dangerous narcotism, ranges from fifteen to forty grains, and the duration of the effect varies in different subjects from two to eight hours. Chloral does not destroy the sensibility to pain, unless administered in a quantity sufficient to suspend the functions of the cerebrum. It is not a pain-relieving agent in the sense that morphine is.

When sleep is produced by proper medicinal doses of chloral the pupil contracts a little, the pulse may remain unaltered or become slower, and the respirations are unaffected. When a dangerous or lethal dose is taken, profound narcotism will follow; the respirations will be slower and shallower, the pulse will become weak, rapid, and irregular; sensibility and the reflex movements will be abolished, and complete muscular relaxation will ensue. The mode of dying is by suspension of the functions of the cerebrum, and, finally, by paralysis of the respiratory center, and of the cardiac motor ganglia. Death may be suddenly produced by paralysis of the heart, in cases of fatty degeneration of the muscular tissue of this organ, without proceeding so far as to involve the lower centers of the brain.

A marked reduction in temperature, notably in rabbits—so much as 8° Fahr.—is produced by chloral, but this effect may be considerably lessened by enveloping the body in non-conductors (Brunton), which act by preventing the cooling of the blood by the atmosphere. The first effect of chloral is to raise the arterial tension (stage of excitement), but this action quickly ceases, and a decided lowering of the tension results. The diminished arterial tension and the weakened action of the heart are the principal factors in the reduction of the body temperature, for the combined action of these agencies is to lessen the combustion process. After death from chloral, congestion of the meninges of the brain and cord, of the lungs, and distention of the right cavities of the heart, have been observed. The arrest of the heart's action takes place in the diastole.

Chloral does not affect the motor nerves nor impair the contractility of muscle ; hence the paralytic phenomena both of animal and of organic life produced by it are due to its direct action on the nervous centers.

Very large quantities of chloral have been taken without producing fatal symptoms. I have seen a patient who took daily from two drachms to three drachms of chloral for many months, without any symptoms of acute poisoning. While it is true that enormous doses (several hundred grains) have been taken without producing lethal effects, it is equally true that serious symptoms and death have resulted from very moderate doses (twenty to thirty grains). Great care should therefore be taken in prescribing an agent of such uncertain power. A fatty heart, atheromatous degeneration of the vessels, advanced disease of the lungs, and instability of the nervous system, are contraindications of the use of chloral.

CHLORAL-HABIT.—The habitual use of chloral constitutes a disorder, which, if not as persistent as the opium-habit, has its own difficulties and dangers of no little importance. Those who take choral habitually have irritable, injected, and rather brilliant eyes, and are voluble in speech, and have a rather excited and hurried manner. They complain usually of singing in the ears, of an empty or vacuous feeling in the brain, and are subject to sudden attacks of vertigo. They are wakeful, and very nervous and excitable, without chloral, when the time for sleep arrives, and they are usually entirely unable to sleep without the usual dose of the hypnotic. During the day they are melancholy, easily fatigued, and their voluntary movements are apt to be uncertain and disordered. The appetite is always capricious, frequently wanting ; digestion is labored ; the secretion of bile is deficient, the stools being rather white and pasty ; the urine stained with the bile-elements, and sometimes albuminous.

An increasing weakness and irregularity in the action of the heart ; dyspnœa, chiefly when the stomach is distended ; redness, injection, and ecchymoses of the skin, have been occasionally observed to occur in cases of the chloral-habit.

The best method of managing these unfortunate cases consists in the very gradual diminution of the daily quantity of chloral ; in regulation of the diet and administration of a suitable supply of food ; air, exercise, and change of scene ; chalybeate tonics ; hyoscyamus and lupuline as calmatives, strychnine and picrotoxin as nerve stimulants ; occasional purgatives.

THERAPY.—Chloral is a remedy of great value in *sea-sickness.* From fifteen to thirty grains every four hours, the recumbent posture for a short time, and suitable nourishment, are the most effective means we now possess for this troublesome disorder. In some cases of *sickness of pregnancy* chloral is equally effective, but, like other remedies for this condition, it often fails. According to the author's observation, it is most effective when there is much dizziness, faintness, and repugnance to food, and but little vomiting. When the odor of chloral invites nausea, as is not unfrequently the case, it may be given advantageously by enema. And, furthermore, rectal injection of fifteen to thirty grains, properly diluted, is an effective remedy for nausea and vomiting of reflex origin, as occur in cases of uterine fibroids, gastroenteritis of children (Kjelberg), etc.

In severe cases of *cholera-morbus*, with cramps, coldness of the surface, cold breath and cold tongue, remarkable relief is procured, and the patient not unfrequently wrested from a condition of extreme danger, by the hypodermatic injection of chloral. There is no means of treatment of *cholera* now known so effective as this, as the author has personally witnessed. The effectiveness of chloral is increased by combination with morphine. ℞ Chloral. hydratis, ʒ iij ; morphinæ sulph., gr. iv ; aquæ laur.-cerasi, ℥ j. M. Sig. : *From fifteen to thirty minims —for cholera, cholera-morbus*, etc. This injection produces considerable burning pain and an indurated lump, but in the author's experience suppuration has not followed.

As chloral produces a lowering of the temperature, and, according to Richardson, diminishes the coagulability of the fibrin, good results may be expected from its use in *inflammations and fevers.* It is especially indicated when the temperature is high and there are much delirium and restlessness present. The author has observed excellent results from its use under these circumstances in the *eruptive fevers, pneumonia*, etc. It should not be forgotten, however, that chloral must be prescribed with caution when there is ischæmia of the arterial system—a condition which must necessarily exist when a considerable portion of the lung-space is blocked up by fibrinous or caseous deposits. In *pleuritis, endo-* and *pericarditis*, and in *peritonitis*, much good will result from the use of moderate doses of choral—five grains every three hours. It is useful because it allays restlessness, causes sleep, lowers the fever, and limits or prevents fibrinous deposits and exudations.

The most important uses of chloral are in diseases of the nervous system. As an *hypnotic*, pure and simple, it is quite unrivaled. Cases of *sleeplessness*, due to mental overwork, anxiety, or physical fatigue, are entirely relieved by fifteen to twenty grains of chloral. The refreshing sleep thus obtained not unfrequently leads to repeated and long-continued use of chloral, and thus the chloral-habit is formed. It follows that sleep should be procured by proper hygienic methods in such cases, if possible, and chloral should be resorted to only after the failure of such means. No hypnotic is so uniformly successful in procuring sleep in *delirium tremens;* but this remedy, as other remedies of the same class, not unfrequently fails. It is more particularly adapted to those cases in which the delirium has succeeded to a debauch, and is less useful, and may, indeed, produce serious symptoms, in old, worn-out drunkards. Violent excitement not unfrequently is produced by it when it fails to cause sleep. The author must caution his younger readers against the too large administration of chloral in this disease. Sleep may be procured which will end in fatal exhaustion. Especially should caution be used in the old drunkard, whose heart and vascular system may have undergone serious fatty and calcareous degeneration. In suitable cases there is no doubt chloral is a remedy of the highest value, but it should not be used to the exclusion of suitable hygienic and dietetic treatment.

Various forms of mania, in which delirium and wakefulness are prominent symptoms, are largely benefited by hypnotic doses of chloral. This remark is true of *acute mania*, *acute melancholia*, *puerperal mania*, *acute maniacal delirium*, and the excitement which occurs in *general paralysis of the insane*. When it agrees, and produces refreshing sleep, marked improvement in the mental state not unfrequently follows its use. In incurable and intractable cases, chloral often renders the greatest service as a calmative and an hypnotic.

Puerperal convulsions, when the patient is in a condition to swallow, may be arrested by full doses of chloral—twenty grains every two hours; also, subcutaneously in five-grain doses, it is highly effective, according to Purefoy, and by the rectum its acts admirably in many cases. *Infantile convulsions*, when due to reflex irritation, may be suspended by the same means. When the jactitations of *chorea* are so incessant as to prevent sleep, or when they occur during sleep, chloral may be administered with advantage. It is not a curative agent in chorea, but when it produces quiet and refreshing sleep it indirectly contributes to the cure.

Some of the respiratory neuroses are greatly benefited by chloral. The paroxysms of *spasmodic asthma* may be arrested by it, and the *spasmodic attacks of difficult breathing* which accompany *emphysema* may be decidedly ameliorated by timely doses of chloral. It must not be forgotten, however, that the use of chloral is not unattended with danger in pulmonary diseases with ischæmia of the arterial system. In the spasmodic stage of *whooping-cough*, great relief to the paroxysms may be obtained by the use of this agent. From five to ten grains will generally be a suitable quantity for administration in these cases. Impending attacks of *laryngismus stridulus* may be prevented, and seizures already in action can be quickly arrested, by a full dose of chloral—five to fifteen grains.

We have no remedy more effective in *tetanus* than chloral, but it must be given in large doses. Nocturnal attacks of *epilepsy* may not unfrequently be prevented by a full dose of chloral at bedtime. In *paralysis agitans*, good effects have been attained by hypnotic doses at bedtime. Chloral is a physiological antagonist to *strychnine*, and may, therefore, be used with advantage in poisoning by this substance.

Chloral is not unfrequently prescribed to relieve *pain*, but under a mistaken notion of its physiological powers. It can only relieve pain by suspending the functions of the cerebrum, and in doses, therefore, which are dangerous. It has no direct pain-relieving power, like morphine. When pain is to be relieved and sleep procured, the combination of chloral and morphine is extremely effective. Although chloral does not directly suspend the functions of the sensory nerves, it relieves certain kinds of pain due to irregular or overaction of unstriped muscular fibers. Very great relief is afforded by chloral to the irregular pains of the first stage of labor, which cause suffering but do not advance the case—the so-called "nagging pains," in popular obstetric language. *Rigidity of the os uteri and soft parts* may be corrected by the timely administration of chloral, and exhaustion may be prevented by giving it in such a way as to suspend irregular uterine action and to procure sleep. *After-pains* are stopped by chloral. In all these cases of obstetric diseases, large doses are generally required.

A solution of chloral is an excellent *antiseptic application to foul wounds:* it destroys the odor of putrefaction, arrests fermentative changes, and promotes the formation of healthy granulations. It may be used to preserve anatomical preparations and morbid specimens. A weak solution of chloral (gr. j to grs. iv—℥ j) is an excellent injection in *gonorrhœa*.

Equal parts of chloral and camphor, triturated together, form a clear fluid, which is often of great service in *neuralgia*, applied to the affected part. It is painted lightly over the surface with a camel's-hair brush, and is allowed to dry on. It is said to allay *spasmodic cough* when painted over the larynx. The solution of camphor and chloral thus prepared has decided solvent properties. Morphine sulphate will dissolve in it in the proportion of a scruple to two drachms, and chloroform can then be added without a separation of the ingredients. A mixture thus prepared is a very effective local application in superficial *neuralgiæ*, and as an internal remedy in *colic*, *cholera-morbus*, *cholera*, etc.

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Croton-Chloral Hydrate.—This substance occurs in rather small and brilliant tabular crystals. It is soluble in water, but not freely so; and, as respects antagonists and incompatibles, may be classed with chloral hydrate. Dose, grs. ij—grs. xv, largely diluted in water. It may also be conveniently made into pills with glycerite of tragacanth.

PHYSIOLOGICAL ACTIONS AND THERAPY.—Croton-chloral resembles chloral in its hypnotic action, but it is feebler and also less certain. As in lethal doses it causes death by paralysis of respiration, it is admissible in cases of weak heart. It differs from chloral, especially in the singular property which it possesses of causing anæsthesia of the head. Croton-chloral is much less certain in its effects than chloral: sometimes one or two grains will relieve severe trigeminal neuralgia; and often from five to fifteen grains are necessary. When pain is to be relieved and sleep procured, the best results are obtained by a combination of the two agents.

Croton-chloral has proved very effective in various *neuralgiæ*. It has been especially useful in *tic-douloureux*, in which it should be given in doses of two to five grains every hour or two, until fifteen grains have been taken. It is probably not safe to exceed this amount at one time. The pains of *dysmenorrhœa* and *sciatica* have also been relieved by the use of this remedy.

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SCHMIDT'S JAHRBÜCHER. Papers by Profs. Liebreich, Benson, Baker, and Wickham Legg, Band 161, p. 16

Chloralamide.—Chloral and formamide. Occurs as a whitish, crystalline substance, having a somewhat bitter taste. It is soluble in water, but not freely so (about 14 to 100) at ordinary temperature. It may be administered hypodermatically, but preferably in the form of powder, or wafer, or capsule. The dose ranges between gr. v and ʒ j, but the hypnotic dose has been fixed at forty-five grains as efficient in most cases in adults.

Actions and Uses.—Chloralamide is not very quick in action—an hour or two elapsing before its characteristic effects are manifest. It is said to be somewhat more prompt when administered by the rectum. It is a hypnotic, lessens the reflexes, acts on the vaso-motor center in the medulla, reducing the blood pressure; lowers the respiratory movements and the action of the heart. When sleep is caused by small doses the repose is quiet, undisturbed by dreams, and no after headache or nausea occur. That chloralamide, as claimed by its proprietors, is absolutely free from untoward effects, can not be admitted; for when massive doses are given the same results follow as are observed from most of the members of the aromatic and fatty series of medicaments—that is, more or less profuse sweating comes on, a rigor announces the onset of an active reaction, and irregular action of the heart and sighing and shallow respiration occur. In sufficient quantity it acts on the blood, also disorganizing the red blood-globules, separating the hæmoglobin, and giving to the blood the characteristic chocolate color, or brownish-black hue, such as the other remedies of the group bring about when freely administered.

A measles-like eruption is apt to appear on the skin; and in one instance Pye-Smith noticed an exfoliation of the skin, as in scarlatina. In this respect, again, chloralamide resembles its congeners.

In its therapeutical applications chloralamide partakes of the effects of its constituents—chloral and formamide. It is an efficient *hypnotic* when wakefulness is not due to pain. It occupies a position between chloral and paraldehyde as a sleep-producer, and, like them, is efficient the less the wakefulness is due to serious disturbances. It has been used with success in the insomnia of fevers and acute affections, but has not succeeded well in *delirium tremens*. In asylum practice chloralamide has been employed in the wakefulness of the insane, but not with a higher measure of success than has attended other approved hypnotics. Dr. Strahan used it in two hundred cases of mental disorder in which insomnia was the chief feature, but he found it no more efficient than chloral or paraldehyde, although it may be safer. Dr. Umpfenbach, an alienist, tried it in many cases of insomnia in asylum practice, but it proved to have no advantages over chloral.

In the wakefulness of *paralysis agitans*, of *sclerosis*, and other cerebral affections it acts favorably. Good results may be expected from its use in nocturnal *epilepsy*. Alt reports favorably on its utility in *chorea*, having effected cures with it when other approved remedies had failed.

Sulphonal.—This name is applied to a chemical product of the same series as chloralamide, and they closely correspond in physiological action. Sulphonal occurs in colorless, tasteless, and odorless crystals, not freely soluble in cold water (1 to 100 or 150), but more freely in boiling water. It is best administered in powder, in wafer, or in capsule. The dose ranges from gr. v to gr. xxx.

Kast, who first investigated the properties of sulphonal, found it to be without toxic qualities; but the large clinical use made of the new hypnotic speedily revealed the fact that it may cause untoward symptoms, and already numerous deaths from it have been reported. It is not actively toxic. Very early attention was called to its dangers, when given in too large doses, by Morandon, Voisin, Falret, and others, and Dr. Petitt, of Dayton, reported a death from its administration to a melancholic after two doses of one gramme (15·4 grains) each. Toxic doses in animals cause death by coma and convulsions, preceded by disorder of muscular movements (Mairet, Knoblauch).

Sulphonal is a certain and comparatively safe hypnotic. To procure the best results from it, certain peculiarities of its action must be regarded. Its hypnotic effect develops somewhat slowly, and from two to four hours elapse after it is taken before sleep comes on. Hence it should be administered early in the evening if it is desired to affect the patient the first part of the night. As the effects of sulphonal come on slowly, so in a corresponding degree they are apt to be prolonged. More or less drowsiness is experienced the next day after a single dose, and it often happens that sleep is better on the second night. Where the administration of sulphonal is rendered necessary for a continuous period, it often suffices to administer a sufficient dose on alternate nights. Combination with trional improves the action, and is often effective. If a dose of trional be administered at bedhour, with sulphonal, the hypnotic action begins promptly, and is carried on through the after part of the night. Thus, sulphonal, gr. x; trional, gr. v. M. Ft. pulv. no. i. The existence of pain, or the febrile state, interferes with its action as a sleep-producer. It is not followed by unpleasant after-effects—by nausea, headache, hebetude of mind. As a hypnotic it has been largely used in asylum practice in all forms of *chronic mental disorders* characterized by insomnia, in *paranoia*, *mania*, and hallucinatory delusions caused by alcoholism, and in *fevers*, *inflammatory diseases*, and other acute and chronic maladies. Valvular disease of the heart does not contraindicate its use.

As compared with chloral, sulphonal is rather more certain and far safer. It is more efficient and safer than chloralamide as a hypnotic merely, although its range of action is smaller.

Trional.—Sufficient experience has now been gained with trional to establish it permanently in the group of hypnotics. It is closely allied to sulphonal, but it is much more prompt in action. Its effects begin in fifteen minutes to a half hour, and continue four to eight hours, according to the size of the dose. It is almost entirely free from unpleasant after disturbances, and does not cause nausea or other stomach distress, nor are confusion of mind and headache results of its impression on the brain. Like other hypnotics of this kind, trional has little power to relieve pain, which in turn affects the hypnotic action. Combination with other remedies of the same group promotes the action of each component of the prescription. This seems to be true especially of sulphonal and trional, as already explained. Dose, five to ten grains, in powder, wafer, or compressed pellet.

Chloralose is a new chemical product with this proprietary designation. It is obtained by the action of chloral on glucose, and is a crystalline substance. The dose ranges from two to five grains. It is said to be an excellent and certain hypnotic, producing its effect without causing any untoward accidents. Further experience is necessary to demonstrate its real place as a remedy.

Amylen Hydrate is, in chemical language, *dimethyl-ethylcarbinol*, a name too unwieldy for common use, and hence the present designation. It is a transparent, colorless liquid, having an odor of a disagreeable kind resembling paraldehyde, and a camphoraceous taste. The dose ranges from five minims to ʒ j. The best vehicle for covering the taste is extract of licorice. For hypodermic administration it may be dissolved in distilled water, in oil of vaseline, or in chloroform water.

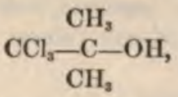
Amylen hydrate appears to have no local irritant action, and is feebly toxic. Very large doses have, it is true, caused stomachal disturbance, but ordinary medicinal doses are free from such effects. The action of the heart and respiratory movements are lowered by it, and febrile temperature is depressed from toxic doses; the reflexes are lessened in activity and ultimately abolished; the normal body-heat is reduced, and profound coma and insensibility ensue. From such a condition of coma and vital depression due to a mistake in the quantity of amylen hydrate given, some patients in the Leipsic Hospital recovered on the third day without any recognizable after ill-consequences. The hypnotic effect follows the ingestion of the remedy in a few minutes—from five to fifteen or twenty minutes—and is rarely postponed to an hour; and if produced by ordinary medicinal doses, no change takes place in the rhythm and force of the cardiac movements, nor in the respiratory movements.

Von Mering, whose experience was gained in Jolly's clinic, was the first to ascertain the powers of amylen hydrate as a hypnotic. Scharschmidt found it to be successful in eighty per cent of his cases as a hypnotic, the subject of these experimental trials being in the clinic of psychiatry. The duration of the sleep is usually six to eight hours. Two to four grammes (30 to 60 grs.) were prescribed on the first trials, but subsequent experience shows that a less amount—from five to twenty grains—will usually succeed in procuring sound sleep of several hours' duration. The existence of pain and other systemic disturbances will interfere with its action.

Amylen hydrate apparently deserves attentive consideration as a hypnotic. Where insomnia is the main condition and no other sources of disturbance exist, it is one of the most promising remedies. In the insomnia of *mental disorders*, Krafft-Ebing has prescribed it with success. By Von Mering it has been used in *delirium tremens* with distinct advantage. Dr. Wildermuth has employed it in epilepsy, and finds it exceptionally useful in cases of the *grand mal*, especially when nocturnal. He found it also to have great utility in the removal of bromism, while at the same time it prevented the recurrence of the epileptic paroxysms.

In various spasmodic and vaso-motor neuroses, such as *asthma, singultus, whooping-cough, tetanus, strychnine poisoning*, it has afforded great relief. The condition of muscular cramp is an indication for its use. Although not an analgesic, it relieves pain indirectly by allaying the cramp which is the cause of pain. In this way it brings about relief to *hepatic colic*, and also, it is said, removes the catarrhal state of the mucous membrane which is the cause of the accompanying jaundice.

Chloretone is a white crystalline substance having a camphoraceous appearance and odor. Its composition, according to Willgerodt, is



$$\begin{array}{c} \mathrm{CH_3} \\ \mathrm{CCl_3{—}C{—}OH,} \\ \mathrm{CH_3} \end{array}$$

and is therefore a trichlor tertiary butyl alcohol.

Chloretone is sparingly soluble in cold water, but is freely soluble in ether, chloroform, acetone, and strong alcohol.

It may be administered in pill, capsule, or powder, and may be inhaled in the form of vapor. When introduced into the stomach or injected subcutaneously or intravenously, or its vapor inhaled, it passes into the blood quickly and diffuses through all parts of the organism. In actual contact with the tissues, it lowers sensibility, ultimately suspending the pain-sense and causing complete anæsthesia if the amount applied is sufficient. As a local anæsthetic its effects are closely allied to those of cocaine. It has a selective action on the brain and nervous system, from which it is obtained in larger quantity than from any other part of the body. It does not affect the composition of the blood nor act on the blood-globules, nor on the hæmoglobin. As regards the circulation, the effects are not those of a depressing agent; the blood-pressure usually remains unaffected and the amplitude of the pulse-wave continues undiminished.

Chloretone administered in any way causes hypnotism and anæsthesia. The functions of the brain, cord, and neurons are ultimately suspended if the amount ingested has been sufficient. It is not eliminated in the form in which it is taken, and does not appear as chloretone in the expired air and in the urine. As the relative proportion of chlorides in the urine is increased by its administration, it is probable that it undergoes oxidation in its passage through the system.

Chloretone is distinctly antiseptic, preventing the decay of organic matters, both solid and fluid, by destroying the organisms concerned in putrefactive decomposition. A solution of five per cent is sufficient to prevent change in organic fluids and to render sterile instruments and vessels.

The therapeutical applications of chloretone are based on its physiological actions. As it is not actively toxic, the dose ranges from 5 to 20 grains, in pill, or tablet, or wafer. As a local application the finely divided powder may be used, or a half-per-cent solution, or, vaporized by heat, it may be inhaled cautiously.

It is a useful local antiseptic and anæsthetic in cases of wounds and injuries requiring such an agent. Internally, in cases of nausea and vomiting, seasickness, ulcer of stomach, vomiting of pregnancy, and similar conditions, it is an efficient remedy.

Chloretone is indicated in insomnia due to painful affection, for it is anæsthetic as well as hypnotic. To procure the best results from its administration in cases of insomnia, it should be given several hours before the expected period of wakefulness.

Dormiol.—Amylene chloral.

Composition and Properties.—By the combination of amylene hydrate with chloral hydrate, *dormiol* is produced. It is an oily, limpid liquid, volatile, and having an aromatic and somewhat pungent taste. It is not decomposed at the boiling temperature. It is soluble in alcohol, ether, benzene, chloroform, and the fatty and ethereal oils. When mixed in equal proportions with water it forms a milky fluid, which gradually clears. This fifty-per-cent solution is utilized for making a preparation for dispensing, by mixing one part with four parts of water, but it must be kept in a cool place and in the dark, as it is liable to undergo decomposition if exposed.

The dose of this ten-per-cent solution is from ʒ j to ʒ iv. When administered as a hypnotic, it has been found to act more efficiently in a single large dose than in a succession of smaller doses.

Physiological Actions.—Applied to the external integument, dormiol causes a burning sensation followed by vesication, and this is surrounded by a reddish erythematous zone. It is an antiseptic, arresting decomposition and destroying foul odors. In the ordinary medicinal administration it does not disagree with the stomach, nor does it impair the appetite. It is not constipating. Dormiol is absorbed promptly, and its actions are manifest within fifteen minutes to a half hour after taking.

As its composition indicates, its effects are expended on the gray matter of the cerebrum, producing quiet and deep sleep, according to the amount taken. Its hypnotic action is not absolutely certain, for it does occasionally fail; but usually it causes quiet sleep, even in conditions of high mental excitement. The duration of the sleep varies from one to ten hours, the average being about five hours, and the subject awakes refreshed, without headache or other disturbances. The circulation and respiration are not affected by ordinary medicinal doses, and it passes through the blood unchanged.

Therapy.—Dormiol's particular sphere of action is as a *hypnotic.* As it is quite prompt in action, it suffices to give an efficient dose a half hour before the expected time. In mental disorders it has been used with much success. It not only procures sleep, but by allaying mental excitement brings about a more healthy mental state. Cures have been effected by its timely and efficient administration. In alcoholic delirium it is more useful and far safer than chloral. As it does not affect the circulation, it may be given whenever wakefulness is to be overcome, quite irrespective of the state of the heart and vessels.

Opium.—Opium. *Opium*, Fr.; *Opium*, Ger. The concrete milky exudation obtained in Asia Minor from the unripe capsules of *Papaver somniferum*, by incision and spontaneous evaporation. (Nat. Ord. *Papaveraceæ*).

Opium should yield at least nine per cent of morphine by the process of assay.

Opii Pulvis.—Powdered opium. Opium dried at a temperature not exceeding 185° Fahr., and reduced to a moderately fine powder (No. 50). It should contain not less than twelve nor more than sixteen per cent of morphine. Dose, gr. j—gr. iij.

Opium Deodoratum.—Deodorized opium. Opium freed from materials soluble in ether—odorous matters, narcotine, etc. It should contain fourteen per cent of morphine. Dose, gr. j—gr. iij.

Emplastrum Opii.—Plaster of opium. (Extract of opium, Burgundy pitch, and lead-plaster.)

Extractum Opii.—Extract of opium. Dose, gr. ss—gr. ij.

Pilulæ Opii.—Pills of opium. Dose, one to four pills. Each pill contains one grain of opium.

Pulvis Ipecacuanhæ et Opii.—Compound powder of ipecacuanha. Dover's powder. Ten grains contain one grain each of ipecac and of opium, and eight grains of sugar of milk.

Tinctura Opii.—Tincture of opium. Laudanum. Thirteen minims or twenty-five drops are equivalent to one grain of opium.

Acetum Opii.—Vinegar of opium. Ten minims or twenty drops are about equal to one grain of opium.

Tinctura Opii Camphorata.—Camphorated tincture of opium. Paregoric. Half a fluid ounce contains nearly one grain of opium. Dose, for children, from gtt. v.—gtt. xx; for adults, from ʒ j— ℥ j.

Trochisci Glycyrrhizæ et Opii.—Troches of licorice and opium. Dose, one to three or four.

Tinctura Opii Deodorati.—Deodorized tincture of opium. Dose, ♏ v—ʒ j.

Vinum Opii.—Wine of opium. (Opium, cinnamon, cloves, sherry wine.) Dose, ♏ v—ʒ j.

Composition.—About half of the weight of opium is made up of gum, pectin, albumen, fragments of the poppy-capsules, and calcareous salts. It contains, also, some coloring-matter, and a volatile substance in minute quantity. The proportion of water varies from twelve to thirty per cent. A large number of basic, acid, and neutral substances have been and are still being discovered in opium, hence its chemistry is very complex.

The following natural alkaloids have been found in opium. Various derivatives of these have also been described. This list, except some unimportant modifications, is taken from Flückiger and Hanbury's admirable Pharmacographia:

Hydrocotarnine.—Crystallizable, alkaline. Volatile at 100°. ($C_{12}H_{15}N_1O_3$.)

Morphine (morphina).—Crystallizable, alkaline. ($C_{17}H_{19}N_1O_3$.)

Pseudo-morphine.—Crystallizes with H_2O, does not unite even with acetic acid. ($C_{17}H_{19}N_1O_4$.)

Codeine (codeina).—Crystallizable, alkaline, soluble in water. ($C_{18}H_4N_1O_3$.)

Thebaine (thebaina).—Crystallizable, alkaline. ($C_{19}H_{21}N_1O_3$.)

Protopine.—Crystallizable, alkaline. ($C_{20}H_{19}N_1O_5$.)

Laudamine.—An alkaloid, which, as well as its salts, forms large crystals. ($C_{20}H_{25}N_1O_4$.)

Codamine.—Crystallizable, alkaline ; can be sublimed. ($C_{20}H_{25}N_1O_4$.)

Papaverine (papaverina).—Crystallizable, alkaline. ($C_{21}H_{21}N_1O_4$.)

Rhœadine.—Crystallizable, not distinctly alkaline ; can be sublimed. ($C_{21}H_{21}N_1O_6$.)

Meconidine.—Amorphous, alkaline ; melts at 58° ; not stable ; the salts also easily altered. ($C_2H_{23}N_1O_4$.)

Cryptopine (cryptopina).—Crystallizable, alkaline ; salts tend to gelatinize ; hydrochlorate crystallizes in tufts. ($C_{21}H_{23}N_1O_5$.)

Laudanosine.—Crystallizable, alkaline. ($C_{21}H_{27}N_1O_4$.)

Narcotine (narcotina).—Crystallizable, not alkaline ; salts not stable. ($C_{22}H_{23}N_1O_7$.)

Lanthopine.—Microscopic crystals, not alkaline. ($C_{23}H_{25}N_1O_4$.)

Narceine (narceina).—Crystallizable as a hydrate ; readily soluble in boiling water or in alkalies. ($C_{23}H_{29}N_1O_9$.)

The only important derivative in the therapeutic sense is *apomorphine*, obtained from morphine by the action of hydrochloric acid. This possesses active emetic property, and will be grouped with emetics.

Besides the foregoing alkaloidal and basic substances, opium contains a peculiar acid (*meconic acid*), and, according to T. and H. Smith, a peculiar form of lactic acid (*thebolactic*).

The proportion of morphine in Turkey opium should not be less than ten per cent, and in good specimens may reach fifteen per cent. Pseudo-morphine occurs in the minute quantity of 0·02 per cent. The proportion of codeine varies from one fifth to two fifths per cent. Thebaine and papaverine exist in Turkey opium in about the proportion of one per cent. Narcotine is found in considerable quantity in different varieties of opium, and ranges in amount from one and five tenths to ten per cent. Narceine varies from 0·1 to 0·71. The quantity of cryptopine and rhœadine is extremely small.

The morphine of opium exists in the drug in the form of the tribasic meconate. The proportion of meconic acid is about three to four per cent of the crude opium.

The value of opium depends on the quantity of morphine which it contains.

Morphina.—*Morphine.* In colorless crystals, which are inflammable and wholly dissipated by red heat. It is scarcely soluble in cold water, slightly so in boiling water, and freely soluble in boiling alcohol. Nitric acid first reddens it, and then renders it yellow. With a solution of sesquichloride of iron, it assumes a deep-blue color. Its solution restores the color of litmus, previously reddened by an acid. (U. S. P.)

Morphinæ Acetas.—Morphine acetate. A white, yellowish-white, crystalline or amorphous powder, slowly losing acetic acid when kept for some time and exposed to the air, having a faintly acetous odor, a bitter taste, and a neutral or faintly alkaline reaction. When freshly prepared, the salt is soluble in twelve parts of water and in sixty-eight parts of alcohol; if it has been kept for some time, it is incompletely soluble in water, unless a little acetic acid is added. Dose, gr. $\frac{1}{6}$—gr. ss.

Morphinæ Hydrochloras.—Morphine hydrochlorate. In snow-white, feathery crystals, wholly soluble in water and in alcohol. Dose, gr. $\frac{1}{6}$—gr. ss.

Morphinæ Sulphas.—Morphine sulphate. In snow-white, feathery crystals, which are wholly soluble in water. Dose, gr. $\frac{1}{6}$—gr. ss.

Pulvis Morphinæ Compositus.—Compound powder of morphine (Tully's powder). (Morphine sulphate, one grm.; camphor, nineteen grm.; glycyrrhiza, twenty grm.; precipitated calcium carbonate, twenty parts; and sufficient alcohol to make sixty grm.) Dose, gr. j—gr. x.

Trochisci Morphinæ et Ipecacuanhæ.—Troches of morphine and ipecacuanha. (Morphine, ipecac, sugar, oil of gaultheria, mucilage.)

Codeina.—Codeine. White, or yellowish-white, more or less translucent, rhombic prisms, somewhat efflorescent in warm air, odorless, having a slightly bitter taste and an alkaline reaction. Soluble in eighty parts of water at 60° Fahr. and in seventeen parts of boiling water; very soluble in alcohol and in chloroform; also, soluble in six parts of ether. Dose, gr. ss—gr. ij.

Various salts of codeine are now prepared, but the sulphate is the most important and desirable.

The other alkaloids of opium are not official.

Narcotinæ Hydrochloras.—Hydrochlorate of narcotine (not official). Dose, gr. ij—gr. x, as an antiperiodic.

Antagonists and Incompatibles.—As regards chemical antagonism, the alkaline carbonates, lime-water, and the salts of iron, lead, copper, zinc, mercury, and Fowler's solution, are incompatible with the preparations of opium. Notwithstanding this chemical incompatibility, the metallic salts are frequently given in conjunction with opium, and the systemic effects of both are produced. Astringent vegetables (tannin) are also incompatible; they limit physiological activity by forming tannate of morphine, which is not readily soluble.

In cases of opium-poisoning, if any portion of the drug remain unabsorbed in the stomach, the most prompt and efficient emetic should be used. Apomorphine should be injected subcutaneously, if the patient is unable to swallow; if conscious, the sulphate of copper may be administered by the stomach. In a case of opium narcosis which resisted ordinary emetics, violent emesis was induced by a solution of bicarbonate of sodium, followed by a solution of tartaric acid. In the absence of other and more active emetics, powdered mustard may be administered—a tablespoonful to a teacupful of warm water. When the opium swallowed is in solution, the stomach-pump should be used if the narcosis is profound. Cold affusion, artificial respiration, when the breathing flags, and faradization of the chest-muscles, are measures of great practical utility. The author has personally witnessed in several cases the excellent effects of faradization, first, in causing such irritation of the surface as to produce reflex excitation of the respiratory center; and, second, inducing contractions of the respiratory muscles. As a peripheral irritant, faradization is more humane and seemly, and also more efficient, than flagellation.

The action of opium is antagonized, at least in a part of the sphere of its influence, by belladonna. These agents are opposed as regards their influence on the intra-cranial circulation, on the pupil, on the respiratory organs, and on the heart. Opium in lethal doses causes paresis of the arterioles and veins; belladonna contracts them, and, by energizing the cardiac movements, substitutes an active for a passive congestion. *It can not be too strongly insisted on in this connection that belladonna in too great quantity, or too long in action, exhausts the irritability of the unstriped muscular fiber, and thus induces the very state which its administration was intended to relieve.* The state of the pupil, the action of the heart, and the condition of the reflex movements, are the guides to the administration of belladonna in cases of opium narcosis. The smallest quantity of belladonna which will dilate the pupil, raise the tension of the arterial system, deepen the respiration, and re-establish the reflex excitability, should be used. The author has a strong conviction, arising from some painful personal experience, that *it is a fatal error to attempt to restore a patient in opium narcosis to complete consciousness by repeated doses of belladonna.* The action of these agents combined is to produce profound sopor, and this is not a condition of danger so long as the pulse, respiration, and reflex movements are in good condition. To substitute belladonna narcosis for opium narcosis is only increasing the hazard under which the patient is already struggling. Impatient to afford relief, and assuming that the tendency to sleep must be obviated, the physician too frequently, as the history of many cases plainly shows, repeats the doses of belladonna until its action greatly preponderates, and the irritability of the cardiac ganglia is completely exhausted. The author, therefore, feels himself warranted in repeating that *the utility of belladonna consists in its power to maintain the action of the heart, and the respiration, until elimination has taken place*, and that even coma is of little importance provided the respiration, circulation, and reflex movements are properly maintained.

The hypodermatic injection of atropine is the most efficient and satisfactory method of employing this physiological antagonist. Not more than $\frac{1}{120}$ of a grain of the sulphate should be administered at a dose, and this may be repeated every fifteen minutes (up to three doses) until dilatation of the pupil, increased power of the cardiac movements, deeper respiration, warmth and dryness of the skin, and flushing of the face, are produced. No more can be accomplished by the largest doses, and the results of the antagonism must be awaited. Belladonna continues longer in action than opium. In a succeeding chapter, devoted to the consideration of the combined administration of opium and belladonna, or morphine and atropine, the nature and degree of the antagonism will be more fully elaborated.

Coffee is also an antagonist to opium, especially caffeine subcutaneously, in doses of three to five grains, repeated as may be required, up to twenty grains. Good results have undoubtedly been obtained by the free use of black coffee, in milder cases of opium narcosis. The unpleasant confusion of mind, and vertigo, which in so many subjects are experienced after the subsidence of the effects of a medicinal dose, may sometimes be removed by a cup of strong coffee. These cerebral effects may be prevented, or relieved when they occur, by a full dose of bromide of potassium. This discovery, if we may dignify so small a matter by so imposing a title, was briefly announced by the author in the first edition of his work on "Hypodermatic Medication."

Gubler has shown that some of the cerebral effects of opium are antagonized by quinine. Tartar emetic and digitalis also oppose to some extent the action of this remedy on the intra-cranial circulation.

SYNERGISTS.—The cerebral and hypnotic effects of opium are promoted by alcohol and its derivatives (notably chloral), and, within certain limits, by the mydriatics. The sudorific action of opium is increased by ipecacuanha.

PHYSIOLOGICAL ACTIONS.—As opium is a very complex substance, made up of numerous principles which differ remarkably among themselves, it will conduce to a better understanding of its actions to consider, first, opium as a whole, and then follow with some details regarding its individual constituents.

The physiological effects of opium are best studied as respects—1, small medicinal doses ; 2, full medicinal doses ; 3, lethal doses.

1. The preparations of opium have a disagreeable, bitter, and rather nauseous taste. Dryness of the mouth and fauces, huskiness of voice, and diminution in the sense of taste, occur in a short time after administration of the drug has begun, and continue during the whole period of its influence. To the dryness succeeds a viscid secretion, which contains excrementitious matter having a foul odor. When opium does not produce nausea, the appetite may not be impaired, may be even increased ; but the rule is that the desire for food is lessened by opium. The secretion of mucus, and of the special glandular apparatus of the gastro-intestinal mucous membrane, is lessened by opium, and hence the digestion and the peristaltic movements are less active. The excretions being thus locked up, dullness and hebetude are experienced, the skin looks muddy, the tongue is coated, and the breath is offensive. When the influence of the opium ceases, it not unfrequently happens that the constipation is succeeded by relaxation of the intestines, and rather profuse and fetid evacuations, and increased urinary discharges, take place.

The action of the heart becomes stronger, and the arterial tension rises. When opium agrees, the sense of fatigue vanishes, and muscular movements become more rapid and easy. The face flushes a little, the pupil contracts slightly, the conjunctivæ may be somewhat injected, and the expression of the eye more brilliant. At this stage the ideas flow more rapidly, but are less sustained and orderly. The appreciation of time, the sequence of events, and the sense of moral fitness, are diminished. The cerebral excitement is, after a period which varies in different individuals, succeeded by calm, by drowsiness, and sleep when it occurs is usually disturbed by visions and dreams, often of a frightful character. In most subjects, after the sopor has passed off, headache, vertigo, confusion of mind, nausea, constipation, and muscular hebetude, are experienced.

2. When full medicinal doses are administered, the symptoms above described occur in a more intense degree. The stage of cardiac stimulation and of cerebral excitement is of much shorter duration ; and the stage of intoxication and sopor not only comes on more quickly, but is much more pronounced. At first the pulse is increased in frequency and the respiratory movements are more rapid ; but the cardiac pulsations soon diminish in number and force, and the respirations become sighing in character and more shallow. There is also present decided dryness of the mouth, fauces, and larynx, and swallowing becomes somewhat difficult and the voice grows husky. Nausea and vomiting, or at least weight and oppression of the epigastrium, ensue. Confusion of ideas, vertigo, somnolence, are succeeded by deep sleep, contracted pupils, slow and relaxed pulse, slow and snoring

respirations, a perspiring skin, and, in many persons, an intense general pruritus, which, however, is more harassing at the nasal orifices.

Persons not habituated to the use of opium usually experience, after a full medicinal dose has expended its force, very distressing sequelæ, referable to the cerebro-spinal system. The most important of these after-effects are headache, confusion of mind, vertigo—which is especially severe on assuming the erect posture—nausea, retching and vomiting, complete anorexia, and constipation. A mild but defined hepatogenic jaundice not unfrequently occurs, and the urine is tinged with the coloring-matter of the bile.

3. A lethal dose of opium causes but a transient excitement; the stage of narcosis quickly supervenes, and the functions of animal life are often rather abruptly suspended. The patient soon lapses into a condition of insensibility, with a slow and feeble, or, it may be, rapid and feeble, action of the heart; slow respiration, shallow and quiet or stertorous; face at first flushed, but soon becoming shrunken, pallid, and cyanosed; skin wet; pupils minutely contracted and insensible to stimulation; unconsciousness profound, with muscular relaxation and abolition of reflex movements. This state of opium narcosis is with difficulty distinguished from alcohol narcosis, from cerebral hæmorrhage—especially in the *pons*—and from uræmic coma. An attentive consideration must be given to all available facts in the history of the case, to the surroundings of the patient, and to the odor of the breath or other excretions, for the symptoms of one of the states above mentioned may be represented in another, even to the inequality of the pupils, since a case of opium narcosis has been reported in which such inequality existed.

There are no characteristic structural alterations produced by opium. The brain presents the appearance known as the "wet brain" by pathologists; the subarachnoid spaces and the ventricles contain an abnormal quantity of serum; the intra-cranial veins are engorged, and the *puncta vasculosa* are somewhat more numerous. The right cavities of the heart and the large venous trunks are usually distended with soft coagula. These appearances are largely due to the mode of dying. In consequence of the diminishing frequency of the respiratory movements, the blood is imperfectly decarbonized, and the capillary circulation of the lungs is impeded. The action of the heart being weak and the resistance *a fronte* increased, it is obvious that venous stasis must take place.

It is necessary now to consider somewhat more minutely the nature and degree of the action of opium on the different organs and systems of the body. It will save space and avoid repetitions to study these actions in connection with the several principles contained in opium.

THE PHYSIOLOGICAL ACTION OF THE ALKALOIDS OF OPIUM.—1.

Morphine.—The peculiar powers of opium are represented chiefly in the morphine which it contains. In opium of good quality the proportion of morphine is from ten to fifteen per cent. The actions of the other principles contained in opium differ widely; and as they all possess some activity, the sum of their effects must so far influence the result that the powers of opium and morphine must vary somewhat in kind as well as in degree. One sixth of a grain of morphine is about equivalent in activity to one grain of average opium.

In general terms, it may be stated that morphine differs from opium in the following respects:

Morphine is less stimulating, less convulsant, and more decidedly hypnotic and anodyne than opium.

Morphine constipates less and affects the contractility of the bladder more than opium.

Morphine has less diaphoretic action and produces much more pruritus than opium.

The physiological action of morphine is best studied as administered subcutaneously. In a short period—from a few seconds to a few minutes—after the insertion of an ordinary dose—one sixth to one fourth of a grain—under the skin, the symptoms of morphine narcosis begin. A sense of heat and flushing of the face—after, in most subjects, a very transient pallor—fullness of the head, giddiness, *tinnitus aurium*, and frequently nausea, are experienced. Deep-seated epigastric pain is often felt, and loud borborygmi occur. The vertigo may be so considerable as to render walking uncertain and staggering, or to render the upright position impossible. Injection of the conjunctivæ and contraction of the pupils occur at the same time the cerebral effects are experienced. The lips have a bluish appearance, the mouth and tongue become dry, swallowing is painful, and the voice has a husky tone. When these physiological effects are produced, pain and spasm are relieved, and an indescribable feeling of content takes possession of the mind. A condition of somnolence in many persons, in others of extreme wakefulness, with intense mental activity, is experienced. When sleep occurs, it is usually deep but not calm, the respirations are slow, noisy, and labored. Not unfrequently the sleep is disturbed by dreams and visions, or the individual passes into a somnambulistic state, from which he is aroused with difficulty. The action of the heart is diminished in frequency, but a decided rise takes place in the arterial tension. On ophthalmoscopic examination, a marked increase in the vascularity of the retina, and blurring of the papillæ, can be discerned.

Soon after a hypodermatic injection has been practiced, itching of the nose, and often of the whole cutaneous surface, is experienced. The skin is at first dry, but, after a time, diaphoresis begins and is sometimes profuse. The relaxation of the skin is coincident with a fall in the arterial tension. The secretions of the mucous surfaces are at first arrested, as well as those of the skin. If the morphine be administered after a full meal, digestion is suspended for a time. The intestinal movements are also arrested for a short period, and constipation is therefore produced ; but, very frequently indeed, no change takes place in the time in which the alvine discharges occur, or in their number. Partly in consequence of the increased action of the skin, the quantity of urine discharged is lessened, and, at the same time, difficulty is encountered in its emission. When the desire is felt, an interval of less or greater duration elapses before the flow begins, and, as the contractile power of the bladder and of the ejaculatory muscles is diminished, the discharge is feeble and slow, and the last drops linger in the urethra.

With the decline of morphine narcosis a majority of subjects, probably, experience headache, confusion of mind, anorexia, and nausea.

When a lethal dose of morphine has been administered by any mode, profound narcotism quickly ensues ; the pulse becomes slow and feeble, or rapid and feeble ; the respirations also become very slow and shallow ; the skin cold and sweating ; the face pale, cyanosed, and ghastly ; the conjunctivæ deeply injected ; the pupils minutely contracted, and reflex movements entirely abolished. Respiration ceases before the action of the heart, as a rule, but in some instances very sudden death ensues from paralysis of the heart.

Half a grain is the smallest dose of morphine which has proved fatal to an adult. Five cases, according to Taylor, have been recorded in which one grain of the muriate caused death.

A consideration of the symptoms produced in man by morphine, and the results of experiments on animals, prove that it chiefly affects the cerebro-spinal functions. In the lower animals, the spinal more ; in man, the cerebral more than the spinal functions. Morphine first raises and afterward lessens the action of the heart and arteries ; first stimulates the pneumogastric end-organs and cardiac motor ganglia, and afterward paralyzes both. It causes death chiefly through paralysis of the muscles of respiration.

2. *Codeine.*—Next to morphine, codeine is the most important of the constituents of opium. These two alkaloids agree in the character but not in the degree of their action. As regards their anodyne and hypnotic properties and their toxic power, codeine has about one fourth the effect of morphine.

In its effects on the nervous system, codeine lessens cerebral activity and the reflexes ; causes sleep which, as compared with the sleep due to morphine, is freer from disturbance ; is less likely to induce after-headache and nausea ; and the various effects on secretion and excretion, so characteristic of morphine, are less pronounced. It is said not to affect the blood pressure, and the pulse remains unaltered, unless the dose is a toxic one. It has, apparently, a selective action on the respiratory apparatus, but it is only by considerable doses that the respiratory movements are retarded. It is supposed to exert a special action on cough through its influence over the pneumogastric nerve. Through the same nerve channel it is probable that codeine is effective in checking that metabolism which results in the production of glycosuria.

The best salt of codeine for hypodermatic injection is said to be the phosphate. The alkaloid itself is too insoluble for subcutaneous administration, and of the salts the phosphate is both more freely soluble and less irritating at the point of insertion. From the therapeutical standpoint it has the conspicuous advantage, as compared with morphine, that there is little danger of a "habit" forming.

3. *Narcotine.*—This alkaloid is singularly inappropriately named. It has but feeble narcotic power. In children considerable doses produce a calmative effect and drowsiness, but these results are not observed in adults. Experiments on animals have shown that narcotine is a convulsant. While pigeons are poisoned only by two or three grains of morphine administered subcutaneously, the same quantity of narcotine causes fatal convulsions. The reverse is true in man. Narcotine is allied in action to berberine, and alkaloids of that group, so far as the effects on man are concerned; and to thebaine, picrotoxin, strychnine, and brucine, so far as the effects on animals are concerned.

Cotarnine.—By oxidation of narcotine an alkaloid is produced which is known as cotarnine. This combines with acids to form salts. The hydrochloride is known as *stypticine*, so named because it is possessed of active styptic properties. It occurs in the form of yellowish crystals, freely soluble in water and alcohol. The dose ranges from gr. ss. to gr. iij, or more.

Cotarnine hydrochloride acts on the nervous system of organic life, controlling hæmorrhage by contracting the vessels. It also slows the heart and raises the arterial tension, the latter because it stimulates the constrictor fibres of the vessel walls. In its action on the vascular system it resembles hydrastinine, but it seems to be more effective than the latter. According to Gottschalk (*Therapeutische Monatshefte*, 1895), it is especially indicated in *congestive dysmenorrhœa*, for it not only controls the hæmorrhage but moderates the suffering. It should be given some days in advance of the flow. It is also used with success in the hæmorrhage of *subinvolution of the uterus*, in *fibroid tumors*, and in the *hæmorrhages* of the climacteric period. Besides uterine hæmorrhage, stypticine should act favorably in *pulmonary hæmorrhage*, secondary to acute hyperæmia of the lungs, in acute congestion of the brain, and in similar states elsewhere. From the physiological standpoint it is indicated in incipient inflammation of organs.

Cotarnine hydrochloride, or stypticine, may be administered in pill form, or in solution, or in combination with agents acting in a similar manner.

4. *Narceine.*—The most contradictory observations have been published on the action of this principle. By Bernard, Béhier, and Eulenburg it is held to possess remarkable hypnotic power, and to be free from stimulating and convulsant action; by Fronmüller, Harley, Da Costa, Mitchell, and others, it is considered feeble, if not inert. The physiological actions of narceine, therefore, remain *sub judice.* Until further researches are made with chemically pure narceine, and by competent observers, it will be safer to give no opinion on the subject of its actions and uses.

The other alkaloids of opium are curiosities of chemical and physiological research, and may be dismissed in a few words.

Cryptopine is in a much greater degree than narceine an hypnotic and anodyne.

Thebaine has a strong convulsant action in animals.

Various circumstances modify the action of opium. These are chiefly *age, sex, idiosyncrasy, habitual use,* and certain states of the system, as the presence of *pain, uræmia,* etc.

The extremes of life are relatively more susceptible to the action of opium, and especially is the susceptibility to its action great in early life. Fatal opium narcosis has ensued in a nursing infant whose mother had taken a medicinal dose. A single drop of laudanum has produced lethal effects in a child under six months of age. Women are more easily affected by opium than men, and they are more apt to be thrown into a condition of hysterical excitement than put to sleep. Nausea, vomiting, headache, and depression much more frequently occur in women than in men. As a rule, therefore—but to this rule there are, of course, numerous exceptions—women are less favorable subjects for the administration of opium than men.

More than age or sex is the action of opium influenced by idiosyncrasy. There are persons so easily affected by it that the minutest quantity will cause uncontrollable vomiting, faintness, vertigo, and alarming prostration. It is never safe to administer morphine hypodermatically to such subjects, unless in an extremely small dose.

The habitual use of opium diminishes in a remarkable degree the susceptibility to its action. Numerous instances are on record in which a pint or more of laudanum has been taken daily, or several hundred grains of opium, or a scruple of morphine. The author has met with a patient who took a scruple of morphine a day subcutaneously. When opium is given by the stomach, for the relief of a chronic painful disease, to maintain a constant effect increasing doses are necessary. The power of the stomach to absorb opium is doubtless impaired by frequent repetition of the dose, and in consequence of the local action of the drug on the nerves of the stomach. Besides this, the susceptibility of the cerebro-spinal system steadily declines. The proof of these statements is afforded by the action of morphine when used subcutaneously for long periods. A gradual increase of the dose becomes necessary in order to produce a given physiological effect; but the increase is much slower than when it is administered by the stomach.

Great pain lessens the influence of opium upon the centers of conscious impressions. The quantity in grains is of much less importance than the quantity as measured by the physiological reactions. Uræmia, or the retention in the blood of urinary excrementitious matters, is supposed to increase the narcotic influence of opium; but some facts, to be hereafter presented, render it probable that the state of uræmia and the influence of opium on the brain are antagonistic.

THERAPY.—*Stomach-pain*, whether simply neuralgic (*gastralgia*), or excited by the presence of food (*irritative dyspepsia*), or due to *ulcer* or *cancer*, is relieved by opium. The preparations of morphine are better than the crude drug, as a rule, in these cases. The endermic application is an excellent mode of procuring relief. The subcutaneous injection, practiced in the epigastric region, is still more effective. Morphine is frequently combined with bismuth, or zinc, or silver salts, in painful stomach diseases. ℞ Bismuthi subcarb., *vel* subnitrat., ʒ iij; morphinæ sulph., gr. j—grs. ij; pulv. aromat., ʒ j. M., ft. pulv. no. xij. Sig.: *A powder in milk before each meal.* The following formula is also useful, notwithstanding its unchemical relations: ℞ Zinci oxidi, ʒ ss; morphinæ sulph., gr. j—grs. ij. M., ft. pil. no. x. Sig.: *One pill, three times a day, before each meal.* A half-grain of the oxide of silver may be substituted for the oxide of zinc in the above formula.

Inflammatory pain, due to corrosive poisons, to *peritonitis*, etc., requires opium. When the stomach is irritable, and the symptoms urgent, the best mode of using the remedy is the hypodermatic injection of morphine. Many kinds of *nausea and vomiting*, stomachal or reflex in origin, are arrested by opium preparations. In vomiting of cerebral origin, or produced by uræmia, or caused by cirrhosis, the use of opium is contraindicated. When vomiting is caused by irritant matters, opium is prescribed after the stomach is emptied. The vomiting which accompanies the passage of *biliary or renal calculi*, *dysmenorrhœa*, etc., is best relieved by opium. Very severe cases of *sea-sickness*, and of the *vomiting of pregnancy*, may be sometimes arrested when all other means fail, by the subcutaneous use of a minute quantity of morphine (one twentieth to one twelfth of a grain).

Nothing is more common than the prescription of opium in *diarrhœal diseases*, but it is often used without a just appreciation of the conditions requiring it. In *acute diarrhœa*, caused by irritating aliments, such astringent laxatives as rhubarb, or mild salines, should precede the use of opium. When the evacuations are watery, the best results are obtained by a combination of opium with mineral acids, or acetate of lead. In *acute dysentery* opium is a very important remedy, but it is often injudiciously employed. If there be fever, much tenesmus, and the stools consist of mucus and blood, the exhibition of opium should be postponed until salines have emptied the intestinal canal of its contents, and have depleted the distended vessels. An excellent method of administration, especially when the dysenteric inflammation occupies the rectum, is an enema of starch or milk, or a suppository, containing opium in some soluble form. In *chronic dysentery* opium is indispensable. It is usually combined with arsenic, or with the salts of silver, copper, or zinc. In the chronic dysentery of malarial origin, the best results are obtained by a combination of arsenic and opium, according to a formula already given; in that form which succeeds to the acute disease, opium and sulphate of copper, or zinc, or nitrate of silver, or vegetable astringents.

Nothing can be more satisfactory than the treatment of *cholera-morbus* by the hypodermatic injection of morphine. It is always desirable to secure the expulsion of irritating matters before resorting to opiates. For an ordinary case of cholera-morbus from one twelfth to one sixth of a grain of morphine suffices. In true *cholera* the utility of opium is most evident in the preliminary diarrhœa, but is entirely without avail in the stage of collapse. Mischief not unfrequently results from its use, for patients emerging from the condition of collapse are either directly narcotized by the opium which had lain unabsorbed in the stomach, or the cerebral symptoms of the secondary fever are greatly intensified by it. In *cholera infantum* opium must be used with caution, if not avoided. The subjects of this malady are easily narcotized, and the nervous system—an unknown morbid state of which bears some close relation to the gastro-intestinal disorder—is rendered so irritable by opium that the symptoms are aggravated by it.

The following formula embodies a truth of great practical importance: *As a rule, opium does harm in all gastro-intestinal maladies in which there is a deficiency in the proper secretion, or a suspension of the functions, of the liver and kidneys.*

Opium gives a degree and kind of relief in *hepatic, renal, and saturnine colic*, which no other remedy or combination of remedies affords. The most prompt and effective form in which the remedy can be administered is the hypodermatic injection of morphine. This relieves the pain, and relaxes the spasm of the affected tube, and at the same time checks the depressing vomiting which attends these cases. The quantity of morphine required will vary from one fourth to one half a grain. As the effect is immediate, the most prudent practice consists in the administration of a small quantity (one sixth to one eighth of a grain) for the first dose, in order to test the physiological capabilities of the patient, and following this in fifteen minutes with a dose of similar size if the first is well borne and the pain persist.

Opium, in small doses, is a valuable tonic to a *weak and dilated heart.* When administered simultaneously with digitalis, it obviates one of the dangers which may be caused by that agent. In the so-called *passive hæmorrhages,* in which not only is the blood altered in quality but the tension is low, small doses of opium sustain the powers of life, and by increasing the arterial tension lessen the transudation through the vessel-walls. Under these circumstances, the dose of opium should not as a rule exceed five minims of the tinctures, and it should generally be given in combination with ergot, digitalis, tannic and gallic acids, acetate of lead, etc.

The important observation was made by Bernard, and afterward illustrated and confirmed by Nussbaum, that the hypodermatic injection of morphine, administered before the inhalation begins, prolongs the stage of *chloroform narcosis* with a less quantity of the anæsthetic, diminishes the danger of cardiac paralysis, and prevents the after-nausea and depression.

Opium is the most important agent which we possess in the treatment of various *inflammations.* Its efficacy depends upon several factors: it relieves pain, quiets restlessness, and thus removes from the inflammatory process one of its most important elements, viz., an irritable and paretic state of the nerves of the affected part. Besides these effects, opium raises the tonicity of the vessels, helps to maintain the continuity of the blood-current, and hinders the migration of the white corpuscles of the blood. It is especially in inflammations of the serous membranes that its highest utility is manifest, e. g., *pleuritis, peritonitis, arachnitis.* Good reasons exist for believing that the hypodermatic injection of morphine will sometimes cut short (jugulate) these maladies, if administered just at their onset. If the period for obtaining such a fortunate result has passed, the course and duration of these diseases can be greatly modified by the judicious use of opium. The quantity of opium required will be determined by the effect; the pain should be relieved, the pupils somewhat contracted. A full dose should be administered at the beginning of treatment (two to three grains of opium—a half grain of morphine), and a given physiological effect be maintained by the regular use of smaller doses. Pain is probably the surest guide, for the existence of pain indicates that decided opium narcosis has not been attained.

In *peritonitis*, whether *puerperal*, *traumatic*, or the extension of *intestinal inflammation*, no fact of therapeutics is better established than the curative power of opium. Besides its immediate influence over the inflammatory process, its indirect action, in maintaining the necessary quietude of the intestines, is of the greatest service. In *arachnitis*, *pachymeningitis*, *basilar meningitis*, there are clinical facts which tend to show that small doses of some opiate preparation really accomplish more than any other remedies. The author is convinced that we possess no means of treatment of *cerebro-spinal meningitis* so effective as the opiate treatment. The same rule as to the quantity required, as that given for peritonitis, should be observed : that quantity of opium should be administered which will relieve the pains and rigidity. The best results are obtained by the hypodermatic injection of morphine. When effusion takes place, and stupor and coma ensue, the utility of opium is ended.

In *parenchymatous inflammations*, experience has shown, opium is much less useful. When pain is a prominent symptom, it can be employed to relieve it ; in small, stimulant doses, it may be given to maintain the action of the heart. In *pneumonia* opium is a remedy of very doubtful utility. Its narcotic action certainly disposes to pulmonary congestion, although it may be cautiously used to allay pain and moderate cough. Although this was the general professional opinion, and is now largely held, there are those who entertain very different views regarding the utility of opium in pneumonia. Thus, Prof. A. L. Loomis, of New York, maintains that the disease may be aborted, or at least decidedly modified in severity, by the subcutaneous injection of morphine in the first stage (congestion) of this disease.

In *fevers*—*typhoid*, *typhus*, and *eruptive fevers*—opium was formerly much more frequently prescribed than at present. The cold baths, antipyretics, and more favorable hygienic influences, have lessened the violence and diminished the mortality from fevers. The maniacal excitement and the low, muttering delirium are not so frequently observed now as formerly, and hence the use of opium in these affections has greatly declined. The discovery of chloral has also diminished the use of opium as an hypnotic. Nevertheless, when there is much restlessness, wakefulness, subsultus, and delirium, opium may render important service. When the delirium is of the low, muttering kind, a small quantity of morphine (one eighth to one sixth of a grain) may suffice to procure quiet and refreshing sleep. When the delirium is violent, combination of tartar-emetic with opium, on the plan of Graves, may have a very happy effect. Or opium may be combined with belladonna, or chloral—the former when the condition is one of great depression, the latter when the delirium and wakefulness are excited in character. In *measles* and *scarlet fever*, when there is a condition of profound depression, the eruption being tardy in making its appearance, and is dusky in hue and ill-defined, beneficial results are experienced from the use of opium, especially when combined with camphor.

A threatened paroxysm of *intermittent fever* may be aborted by the hypodermatic injection of morphine (one fourth of a grain). This practice has a high degree of importance in the *pernicious intermittents*, when time is not afforded for an effective use of quinine. The febrile heat of *intermittent and remittent fevers* may be diminished, and the sweating stage induced earlier, by the use of opium in moderate doses (ten minims of the deodorized tincture every two, three, or four hours). The addition of morphine to quinine enables the latter to be better borne by the stomach, counteracts some of its unpleasant effects on the brain, and increases its therapeutical power. When no contra-indication to the use of morphine exists, it is good practice to combine it with quinine in the treatment of intermittent and remittent fevers.

Narcotine has decided antiperiodic power, and may be given as a substitute for quinine when reasons exist to prevent the use of the latter. From five to ten grains of pure narcotine may be administered. As an antiperiodic it ranks after arsenic, salicine, and even apiol.

As an *hypnotic* opium is very frequently used in affections of the nervous system. The stimulant properties of crude opium, or its official preparations, render it less serviceable than morphine in the group of cases generally requiring an hypnotic. There can be no doubt that remarkable curative results have followed the hypodermatic injection of morphine in *acute mania*. The following are the indications for the use of morphine in mental disorders: prolonged wakefulness, maniacal excitement, persistent refusal of food, drink, or medicine, destructive and suicidal tendencies. As respects individual subjects, the state of the arterial tension furnishes a guide to the use of morphine. If the tension of the arterial system is low, a small dose is required. When the pulse is quick, and the arterial tension high, a large dose of morphine, by over-excitation, causes paresis of the sympathetic, and thus reduces action, an indication for the full influence of the agent. Large doses of morphine, when given subcutaneously, require the utmost circumspection in maniacal cases, especially in obese and aged subjects. Besides acute mania, excellent results have followed from the use of morphine in *lypemania* (Krafft-Ebing, Voisin), in *chronic mania*, and *melancholia*. Probably the best effects have been witnessed from opium in *melancholia*. In this mental disorder, which is a condition of depression, the best form for the administration of opium is the tincture, and the dose required is the stimulant and not the narcotic dose. The author is impelled to add the caution so well expressed in the following words by Maudsley: "It will be well to have in mind that neither opium by the mouth, nor morphine hypodermically injected, will always quench the fury of acute mania, and that successive injections of morphine, followed by brief snatches of fitful sleep, have been followed also by fatal collapse."

It was formerly held that large and increasing doses of opium were necessary for the cure of *delirium tremens*, the theory being entertained that to procure sleep was to insure recovery. It is now known that to re-establish digestion and to support the powers of life by suitable nutrients are in a large proportion of cases the only means needed to quiet delirium and to cause sleep. Opium, if used at all, must be given cautiously. Chloral has to a large extent taken its place as an hypnotic in this disease, but cases are not unfrequently met with in which morphine agrees better, and is more effective in inducing quiet.

Some cases of *sunstroke, coup de soleil*, or "thermic fever," are rapidly cured by the hypodermatic injection of morphine. When the patient is able to swallow, good effects follow the conjoined administration of tincture of opium and brandy. The cases benefited by this treatment are characterized by pallor of the face and weakness of the heart—heat exhaustion.

Epilepsy and *epileptiform* seizures may be sometimes prevented by the timely administration of morphine hypodermatically. This treatment is best adapted to epilepsy, the attacks of which occur at night, to *petit mal*, and to *convulsive tic*. It is improper in epileptoid seizures due to tumor or other coarse organic lesion of the brain. In suitable cases, this treatment procures most decided amelioration in the condition of the patient, but may induce the opium habit.

The remarkable fact has been demonstrated by Loomis, of New York, that we have in the hypodermatic injection of morphine the most important agent for the cure of *uræmic convulsions, puerperal and non-puerperal*. It is true this mode of treatment had been originally practiced by Scanzoni, but Loomis has, more especially, drawn attention to its real power and utility. "The most uniform effect of morphine so administered is, first, to arrest muscular spasms by counteracting the effect of the uræmic poison on the nerve-centers; second, to establish profuse diaphoresis; third, to facilitate the action of cathartics and diuretics, especially the diuretic action of digitalis."

In *chorea* Trousseau has carried the administration of morphine to an extraordinary extent. He restricts its use to severe cases, which appear to have a singular insusceptibility to the action of opium even in enormous doses. When the jactitations are incessant, preventing sleep, or persisting in spite of sleep, the utility of morphine is very great. It is most effective when combined with chloral. In these severe cases of chorea, the only limit to the quantity of morphine is the effect produced. It is evident, from the experiences of Trousseau, that very large doses are required, and that curative effects are thus obtained to which small doses are entirely inadequate. The subcutaneous method is more efficient than the stomach administration.

In *tetanus* and *hydrophobia* the use of morphine has been chiefly palliative. M. Demarquay has, however, applied morphine, by deep injection into the tetanized muscles, with greater success than heretofore. He carries the needle deeply into the tetanized muscles, and, if possible, to the point of entrance of the nerves. He injects in this way the masseters, the sterno-cleido-mastoid, the neck and sacro-lumbar muscles, etc. The relaxation of the muscles of mastication thus induced permitted the nourishment of the patients. Of three cases thus treated during the siege of Paris two recovered and one died, but the death was due to pyæmia and not to tetanus.

The most important uses of opium and its various preparations are in the relief of *pain*. In surgical practice its administration is indispensable to prevent or mitigate *shock*, to quiet *pain*, and to check *inflammation*. To particularize on these points would require an epitome of surgery for illustration. Before the administration of chloroform, morphine should be injected hypodermatically, to diminish the dangers of the inhalation and to secure relief to the after-pain of the surgical operation. Nothing is more universal in surgical practice than the administration of an opiate after an operation of any magnitude, for the objects above named.

The most signal service is rendered by opium and its preparations in the various *neuralgiæ*. The most effective mode of administration is by subcutaneous injection, and the remedy should be inserted in the neighborhood of the affected nerve, notwithstanding that relief is afforded by the injection at any point. In *tic-douloureux*, *brachialgia*, *cardialgia*, *gastralgia*, *hepatalgia*, *nephralgia*, *sciatica*, and *pelvic neuralgiæ*, immediate relief is afforded by this remedy, and the relief is not temporary and palliative merely, but curative in numerous instances. It appears to be especially curative in *sciatica*. It is a remarkable fact that morphine inserted under the skin, and especially in the neighborhood of affected nerves, exerts a curative power which it does not at all have when administered by the stomach. An efficient method of using morphine in the treatment of neuralgiæ, according to Brown-Séquard, consists in applying it in a finely-divided state to the derma, denuded by a blister. Lafargue proposed the method of inoculation, which consists in inserting morphine into the skin by means of a lancet-puncture. These clumsy and painful processes are by no means equal to the hypodermatic method.

The enchanting sense of relief to suffering wrought by opiates, and especially by the subcutaneous use of morphine, leads to the morphine-habit. It is a singular fact that in these cases the pains which were [illegible] withdrawn, and other painful [illegible] In practicing the hypodermatic [illegible] in severe cases of neuralgia [illegible] the morphine-habit.

[illegible] great relief is often afforded [illegible] forms. No remedial agent [illegible] as the hypodermatic use of [illegible] breathing which occur in [illegible] the same way. But there is great danger of establishing the opium-habit in these chronic cases. In [illegible]—[illegible] or *autumnal catarrh*—the hypodermatic use of morphine is quite as effective as in spasmodic asthma. An [illegible] may be aborted by a full dose of Dover's powder [illegible] at the very outset of the inflammation. Morphine and [illegible] are rather more effective than Dover's powder in these cases. Opium, or some of its preparations, enter into the composition of expectorant mixtures to *allay cough*.

The hypodermatic injection of morphine has been shown to possess a high degree of utility in cases of *dilated heart with difficult breathing*, and *general oedema*. The eighth to the sixth of a grain suffices for this purpose. The effect it has is to quiet and regulate the action of the heart, to allay the distress of breathing, and to permit rest and sleep in the recumbent position. An occasional dose only is necessary (two or three times a week).

Opium is a very important addition to our resources in the treatment of *diabetes*. It must be given in considerable doses, as Pavy has shown. From six to twelve grains a day are necessary, in order to produce a decided impression. It checks the bulimia—the inordinate appetite—allays thirst, diminishes the flow of urine and the excretion of sugar, and, probably, arrests or prevents the changes in the nervous system which accompany or are causative of this disease. Although many cases are decidedly ameliorated, it can not be said that any have been cured by opium. Codeine, an alkaloid of opium, seems to be more effective in this disease than the crude opium or any of its preparations. It must be given in full doses. Besides checking the waste, it apparently exercises an influence over the central nerve-changes, and thus has a curative action as well as merely palliative.

EXTERNAL USES OF OPIUM.—A solution of morphine in distilled water is an excellent astringent anodyne in *conjunctivitis*, and, combined with atropine, in *iritis*. ℞ Morphinæ sulph., grs. iv—grs. viij; aquæ destil., ℥ j. M. Sig.: *A few drops to be put into the eye as necessary.* ℞ Morphinæ sulphatis, grs. iv; zinci sulphatis, grs. ij; aquæ destil., ℥ j. M. Sig.: *Lotion for iritis and other inflammatory affections of the eye.* The last formula, omitting the zinc, is an excellent application in *earache*, the external meatus being filled with it, and in *toothache*, a few drops on cotton being placed in the hollow of the tooth.

Local inflammatory swellings, painful in character, can be relieved somewhat by poultices containing laudanum. Frictions with laudanum are serviceable in *lumbago, sciatica, myalgia*, and similar superficial painful affections. An infusion of opium (ʒ j—Oj), applied hot, is an excellent application to *inflamed joints, inflamed testicle*, etc.

On the Combined Uses of Opium and Belladonna, Morphine, and Atropine.—The conjoined use of these agents is so important a subject from the point of view of practical therapeutics, that the author purposes to consider it under this head. Although a physiological antagonism as respects a part of their action unquestionably exists, it does not extend throughout their whole range of influence in the organism. The balance of actions furthermore produces results which neither is capable of singly. Hence the importance of a more direct presentation of these points than has been heretofore given.

Both act on the brain, atropine causing delirium, hallucinations, and disturbed sleep ; morphine producing stupor, somnolence, hebetude of mind. Both relieve pain, but this effect is much greater in the case of morphine. Both produce disorders of motility, staggering, difficulty of co-ordination of muscular movements, vertigo, confusion of mind, and headache. The reciprocal influence exerted upon each other, when they are administered together, modifies in a remarkable manner their physiological effects.

Morphine corrects the illusions and phantasms produced by atropine. In small doses (e. g., one ninety-sixth of a grain) atropine increases the hypnotic power of morphine, with the result of causing a less disturbed and more nearly normal sleep than is produced by morphine alone. If, however, the quantity of atropine be in excess of what is necessary to establish the physiological balance in the cerebrum, it overrides the action of morphine and asserts its own peculiar power of inducing phantasms, illusions, and hallucinations.

The pain-relieving power of morphine is rather increased than diminished by atropine. The disorders of motility are enhanced by the mutual reactions of the two agents. The after-headache, vertigo, nausea, and depression of the heart's action caused by morphine, are to a large extent prevented by the conjoined administration of atropine. When a large quantity of opium, or morphine, is given by any of the modes of administration, its immediate depressing effects are counteracted by the simultaneous use of belladonna or atropine. Morphine produces contraction of the pupil, and a tetanic condition (according to Graefe) of the muscle of accommodation ; atropine causes dilatation of the pupil and contraction of the ciliary muscle. When used together these effects may be precisely balanced. It requires but a minute quantity of atropine to overcome the action of morphine on the pupil. When these effects on the pupil are balanced it does not follow that the muscle of accommodation is in a normal condition, for visual defects remain. Morphine prevents the contraction of the arterioles produced by atropine, and, as a necessary consequence, the subsequent relaxation of the muscular fiber.

Morphine depresses the action of the lungs: atropine is a powerful respiratory stimulant. Morphine produces pallor of the surface, and reduces the external temperature: atropine causes redness and injection of the skin and elevation of the body-heat. In some experiments the author ascertained that while atropine alone raised the pulse to 105 from 72, atropine and morphine combined depressed the pulse of the same subject to 60.

Both morphine and atropine produce dryness of the mucous membrane of the mouth and fauces. Morphine suspends, and atropine increases, the peristaltic movements. The sickness and nausea caused by morphine are, to a considerable extent, lessened or prevented by atropine.

Morphine lessens and atropine increases the functional activity of the kidneys; on the skin their effects are opposed; hence, when used in combination, the urinary secretion is rather increased than diminished by them. Both produce dysuria.

THERAPEUTICAL APPLICATIONS OF OPIUM AND BELLADONNA.—Whenever opium is used to *relieve pain*, to *procure sleep*, to *relax spasm*—there being no inflammatory action present—belladonna should be combined with it, unless some contraindication should exist to the action of the latter. This formulated expression is more especially applicable to the hypodermatic use of morphine.

In the various *psychical disorders*, in which the general condition is sthenic, opium or morphine should be used alone. When power is deficient, the forces depressed, the temperature rather below than above the normal, belladonna or atropine should be combined with the opium or morphine. For the relief of *insomnia* the combined action of these agents is much more effective than either singly. The proportion in which the alkaloids should be used is about as follows: $\frac{1}{120}$—$\frac{1}{100}$ of a grain of atropine to $\frac{1}{2}$ and $\frac{1}{4}$ of a grain of morphine.

In the *various convulsive disorders* in which opium or morphine may be used, especially hypodermatically, atropine should be combined with it.

The *neuralgiæ* are best treated by morphine and atropine combined, for the following reasons: the combination is more effective, the after-unpleasant effects of either are prevented to a considerable extent.

The *neuroses of the respiratory organs*, of the *abdominal viscera*, etc., are, as a rule, more successfully treated by morphine and atropine in combination, than by either separately.

In *surgical diseases and operations of various kinds*, the combination of morphine and atropine has most important and varied applications, among which may be enumerated : *to render safer and to prolong ether or chloroform narcosis ; to prevent or relieve shock ; to save suffering ; to relax muscles ; to facilitate operative procedures.*

The combined administration of morphine and atropine is of the greatest service in obstetric practice : *to relieve the teasing pains of the first stage ; to procure sleep in the course of an exhausting labor ; to quiet after-pains ; to facilitate the performance of various obstetric operations ; to arrest puerperal convulsions.*

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Humulus.—Hops. The strobiles of *Humulus lupulus* Linné (Nat. Ord. *Urticaceæ, Cannabineæ*).

Lupulinum.—Lupuline. The glandular powder separated from the strobiles of *H. lupus*. *Lupuline*, Fr.; *Hopfendrüsen*, Ger.

Infusum Humuli.—Infusion of hops (℥ ss—Oj). Dose, a teacupful or more. (Not official.)

Tinctura Humuli.—Tincture of hops (twenty parts to one hundred). Dose, ℥ ss—℥ ij.

Oleoresina Lupulini.—Oleo-resin of lupuline. Dose, ♏ v—ʒ ss or more.

Extractum Lupulini Fluidum.—Fluid extract of lupuline. Dose, ʒ ss—ʒ ij.

Composition.—Hops contain *lupuline* (described above), a tannic acid, an essential oil composed in part of *valerol, trimethylamine*, and a liquid volatile alkaloid, *lupuline* (?).

Physiological Actions.—Hop is an aromatic stomachic tonic, and as such promotes the appetite and digestive power. It is slightly astringent also. The action of the heart is somewhat increased, the cutaneous circulation excited, and diaphoresis produced.

In a very slight degree, hop first causes cerebral excitement, followed by calm and a disposition to sleep. Experience has shown that it possesses some anaphrodisiac property, and lessens the functional activity of the testes and the apparatus of erection.

Therapy.—As a *stomachic tonic* hop is quite as serviceable as many more rare and costly medicines. It is useful in *atonic dyspepsia*, simple *flatulent colic*, and *mild diarrhœas*.

The power of a hop pillow to *quiet the mind* and to *induce sleep* seems to be well established, but its influence is, doubtless, largely due to imagination and the association of ideas. The tincture of lupuline and the oleo-resin are useful remedies in mild cases of *delirium tremens*. They serve a double purpose—as a stomachic tonic and cerebral sedative. A combination of fluid extract or tincture of lupuline and tincture of capsicum is probably the best *substitute for alcoholic stimulants*, when the habit of their use is to be discontinued. ℞ Ext. lupulinæ fluid., tinct. capsici, āā ℥ j. M. Sig.: *One or two teaspoonfuls as necessary.* The condition known as *horrors*, or the wakefulness and excitement which just precede the attack of delirium tremens, may often be quite removed by free use of this combination.

Nocturnal seminal losses may be reduced in frequency by the use of lupuline, of which the best preparation for this purpose is the oleoresin. *Chordee* is said to be prevented by the use of lupuline, but the author has been quite disappointed in his attempts to relieve this state by this remedy.

A hop poultice or bag is a domestic remedy for *internal pains* and *inflammation*, especially of the abdominal organs. A quantity of hops is sewed into a muslin bag, dipped in hot water, and then laid over the affected region. It forms a light fomentation, which owes its virtues rather to the heat and moisture than to the anodyne qualities of the hops.

Lactucarium.—Lactucarium. The concrete milk-juice of *Lactuca virosa* Linné (Nat. Ord. *Compositæ*). (U. S. P.) Dose, gr. v—ʒ j.

Tinctura Lactucarii.—Dose, ʒ ss—ʒ ij.

Syrupus Lactucarii.—Dose, ʒ j—ʒ iij.

COMPOSITION.—Lactucarium contains several organic substances and eight to ten per cent of inorganic matter. It yields about fifty-eight per cent of *lactucerine* or *lactucone*, an inodorous, tasteless neutral substance, a crystallizable bitter principle, *lactucine*, and *lactucic acid*.

PHYSIOLOGICAL ACTION, AND THERAPY.—The soporific quality of lettuce is known to all who eat this vegetable. Notwithstanding this universal experience, careful experiments have shown that lactucarium possesses a very feeble hypnotic quality, if it be not entirely inert. It is only used as a substitute for opium and its alkaloids when these disagree. The sirup of lactucarium is prescribed to relieve cough, but it is better employed as a vehicle for more powerful agents of the class of expectorants.

Bromides.—*Ammonii Bromidum.*—Ammonium bromide. *Bromure d'ammonium*, Fr.; *Bromammonium*, Ger. Colorless, transparent, prismatic crystals, or a white, granular salt, becoming yellow on long exposure to air, odorless, having a pungent, saline taste, and a neutral reaction. Soluble in 1·5 part of water and in 150 parts of alcohol at 60° Fahr.; in 0·7 part of boiling water. Dose, gr. x—ʒ ss, or more, well diluted.

Calcii Bromidum.—Calcium bromide. A white, granular salt, very deliquescent, odorless, having a pungent, saline, and bitter taste, and a neutral reaction. Soluble in 0·7 part of water and in 1 part of alcohol. Dose, ℈ j—ʒ ij.

Camphora Monobromata.—(For description, see article CAMPHORA.)

Ethyl Bromide.—(For description, see article ÆTHER.)

Lithii Bromidum.—Lithium bromide. A white, granular salt, very deliquescent, odorless, having a very sharp, somewhat bitter taste, and a neutral reaction. Very soluble in water and in alcohol. Dose, gr. v—℈ij.

Potassii Bromidum.—Potassium bromide. *Bromure de potassium*, Fr.; *Bromkalium*, Ger. Colorless, translucent, cubical crystals, permanent in dry air, odorless, having a pungent, saline taste, and a neutral reaction. Soluble in 1·6 part of water and in 200 parts of alcohol at 60° Fahr. Dose, ℈j—ʒij.

Sodii Bromidum.—Sodium bromide. Small, colorless, or white monoclinic crystals, or a crystalline powder, permanent in dry air, odorless, saline taste and neutral reaction. Soluble in 1·2 parts of water and 13 parts of alcohol. Dose, ℈j—ʒij.

Antagonists and Incompatibles.—Acids, acidulous and metallic salts are incompatible with bromides of ammonium and potassium, and nitrous ether with the former. The physiological actions of the bromides are antagonized by cold, digitalis, belladonna, ergot, and other agents which energize the vaso-motor nervous system.

Synergists.—Opium, chloral, and remedies belonging to the same group, promote the action of the bromides on the brain; and aconite, veratrum viride, gelsemium, etc., increase the depressing effect of the bromides on the circulatory system.

Physiological Actions.—The taste of a bromide is bitter and saline. In a short time after it is swallowed, the characteristic taste returns to the mouth, owing to the outward diffusion of a portion of that administered. The tactile sense of the fauces, as also the muscular movements in the act of swallowing, are diminished by long-continued use of the bromides.

Sixty grains of the bromide of potassium or sodium, and a less quantity of the ammonium salt, will in some persons produce slight nausea and diarrhœa; in others, a sense of coolness in the epigastric region; but in many, provided the salt is properly diluted, no effect on the stomach. Gastric catarrh is undoubtedly one of the evil results which may follow the protracted administration of the bromides in considerable doses.

These are diffusible substances, and hence pass quickly into the blood. When large doses are administered and insufficiently diluted, it is probable that no inconsiderable portion escapes absorption, for they can be detected in the intestinal mucus and in the fæces.

Very obvious effects on the action of the heart, on the respiration, and on the animal temperature, are produced by the bromides if administered in considerable quantity. These functions are depressed, but the depression is much less evident as to temperature; hence, in order to determine this result, most careful observations are necessary. The author has ascertained that two drachms of bromide of potassium will lower the temperature in a healthy adult from one fifth to one half a degree; the respirations from two to five, and the pulse from ten to twenty beats per minute. These effects are more pronounced in animals, as ascertained by the administration of lethal doses. In man the number of the cardiac pulsations is not only reduced, but their force is diminished, and the tension of the arterial system is lowered.

A transient excitement, intoxication, giddiness, in some persons an anxious mental state, are produced by one or several large doses. As a rule, slight somnolence, and sounder and more refreshing sleep result, provided no disturbing element intervenes. The pupil is not affected in its size and sensibility to luminous impressions in an adult man by a dose of one hundred and twenty grains. When long continued, the hypnotic effect is much more pronounced, and a constant drowsiness is experienced. The sensibility to pain, but especially the sensibility to tactile impressions, is lowered by the bromides at all accessible points of the mucous membrane, and of the skin—notably of the plantar surfaces of the hand and foot. The diminution of the sensibility of the mucous membranes is in part due to a local action of the salt as it is being eliminated.

Motility is impaired by the long-continued use of the bromides in man, and in animals paralysis of the muscles ensues. If injected into the tissues of a limb, paralysis of motion and sensibility begins in that member. In man the impaired motility is probably due to other factors as well as to the action of the bromides on the muscular tissue, viz., to the cutaneous anæsthesia, and to an anæmia of the co-ordinating centers, in consequence of which their functional power is lowered.

A very notable effect of the bromides—chiefly bromide of potassium—is the diminution of the sexual feeling and of the power of erections produced by it. This fact has been established by abundant clinical evidence. The result is not, however, produced with equal facility in all cases, and considerable doses are necessary in any case.

Prolonged administration of the bromides develops a peculiar state, to which the term *bromism* is applied. This condition of chronic poisoning differs from the effects of a few medicinal doses in the extent and intensity, but not in the character, of the symptoms. The following were the symptoms of bromism, as observed in an epileptic boy, to whom two drachms of the bromide of potassium had been administered daily for a month: extreme pallor and anæmia, dilated pupils, acne on face, forehead, and shoulders; a fetid, bromine breath; slow and feeble action of the heart; breathlessness, and quickened pulse on slight exertion; cool hands and feet; a general subjective sense of coldness; movements in walking tremulous and uncertain; diminution of the tactile sensibility of both cutaneous and mucous surfaces; fauces dry, and the reflex movements sluggish; swallowing somewhat difficult; antaphrodisia and complete relaxation of the genitals; mind weak, manifested in silly conduct and unmeaning laughter.

Various mental symptoms are in some subjects produced by the long-continued use of the bromides. Weakness of mind, without perversion of intellection, is a very constant result of the continued use of large doses. Headache, confusion of mind, and a peculiar intoxication, had long ago been observed to follow the use of the bromide of potassium in even moderate doses (Puche). A form of mental derangement, with hallucinations of a melancholic character, has been observed by Hammond and others, and in a few instances a pleasurable intoxication, with exalted ideas, has been produced (Bannister).

The pallor and anæmia of bromism are due to several causes: to the diminished action of the heart; slowness of the capillary circulation, and consequent interference in the metamorphosis of tissue; derangement of digestion and assimilation in consequence of gastric catarrh; and diminished blood-supply to the cerebro-spinal axis. The disorders of voluntary movement, the uncertain gait, the apparent defects of co-ordination, are variously explained; but, they are doubtless made up of several factors, of which the cutaneous anæsthesia is the most influential. The bromides possess the power to destroy or impair the irritability of the motor and sensory nerves, and the contractility of muscle, and to these effects must be attributed in part the disorders of voluntary movement noted above.

It is very obvious that the bromides depress certain organic functions: they diminish the action of the heart, lower the animal temperature, and lessen the blood-supply to various organs. These results can only be accomplished by a sedative influence on the sympathetic system. Some very accurate observers have maintained that in this action lies all of the physiological power of the bromides (Reynolds, Amory).

Effects of the Bromides compared.—There is a general correspondence in the actions of the different bromides. As respects their influence on the pulse, body-heat, and respiration, the author's comparative experiments have demonstrated that these agents stand to each other in the following order: bromide of sodium, bromide of lithium, bromide of potassium, bromide of ammonium. Very notable differences exist between the bromide of ammonium and the others, due, undoubtedly, to the character of the base.

The author's experiments on animals further demonstrated the following: bromide of potassium possesses the most toxic power, and bromide of sodium the least. The bromide of lithium is first, the bromide of sodium second, and the bromide of potassium third, in hypnotic power. As respects the influence of these agents severally on the reflex faculty of the spinal cord, it may be stated that none of them possess the power to abolish the reflex faculty except when administered in sufficient quantity to produce lethal effects. Considered from this point of view, the bromides may be grouped as fol lows: bromide of ammonium, bromide of potassium, bromide of lithium, bromide of sodium.

The elimination of the bromides takes place through the mucous membrane of fauces, intestinal canal, and bronchi, through the skin, but chiefly by the kidneys. The rate of elimination varies, but is usually slow, several days being occupied in its diffusion outwardly from the blood.

THERAPY.—In some kinds of *vomiting* the bromides are most serviceable. The form of vomiting, to the treatment of which they are best adapted, is the reflex and the cerebral—as *the vomiting of cerebral congestion, sea-sickness, pregnancy,* etc. They are contra-indicated in all cases of vomiting due to primary gastric disturbance.

In the *abdominal neuroses,* of which *cholera infantum* is a type, the bromides are often highly effective, as the author has long known, and as Spender has lately advocated; but, according to the author's observation, it is useless, if not injurious, when defective alimentation is the cause of the attacks, and is serviceable just in proportion to the degree in which an irritable state of the nervous system dominates the gastro-enteric disturbance. When the cause of the attacks is heat, or reflex irritation of the fifth pair, as in teething, or cerebral congestion, very excellent results are obtained from the use of the bromide of potassium. ℞ Potassii *vel* sodii bromidi, ʒ ij; syrup. simplicis, ℥ ss; aquæ menthæ pip., ℥ jss. M. Sig.: *A teaspoonful every hour or two.* The author has had excellent results from the use of the bromides in the *flatulent colic,* the *restlessness,* and *crying fits* of infants. ℞ Potassii *vel* sodii bromidi, ʒ j; ol. anisi, ♏ ij; mucil. acaciæ, aquæ menthæ pip., āā ℥ j. M. Sig.: *A teaspoonful every half-hour until relief is experienced.*

Increased action of the heart (hyperkinesis) due to irritation of the sympathetic, as, for example, such as occurs in exophthalmic goitre, is calmed by the bromides. The irregular and too frequent action of the heart, occurring in hysterical subjects of plethoric constitution, is generally relieved in the same way; but the bromides are contraindicated in all cases dependent on anæmia. Disturbed action (overaction) of the heart, with cerebral hyperæmia, is frequently most advantageously treated by a combination of digitalis and a bromide: ℞ Inf. digitalis, ℥ iv; potassii bromidi, ℥ ss—℥ j. M. Sig.: *A tablespoonful morning and evening.*

Da Costa has, in several publications, strongly urged the use of the bromide of ammonium in *acute rheumatism.* Doubtless, other bromides (potassium, sodium, lithium) would be as effective, and are certainly much less disagreeable. The author has used the bromide of lithium with considerable apparent success, in *subacute rheumatism,* in *rheumatic gout,* and to remove the *stiffness* and *nodosities of joints* remaining after attacks of the above-named rheumatic affections. The wakefulness, delirium, and hyperpyrexia, which sometimes complicate rheumatism and gout, are best treated by bromide of lithium, pain being relieved by morphine if necessary.

It has been stated that the bromides, especially bromide of ammonium, diminish the deposition and hasten the retrograde metamorphosis of the fat in *obesity*. Undoubtedly these agents increase waste, but they do so, chiefly, in consequence of a severe gastric catarrh which they set up.

Rabuteau has proposed the use of the bromides as eliminating agents in cases of *mercurial*, *cupric*, or *saturnine poisoning*. These agents, more efficiently than the iodides, combine with the deposited minerals, convert them into soluble combinations, and thus cause their elimination. The best results are probably obtained by a combination of the bromide and iodide of potassium.

The most important therapeutical applications of the bromides of potassium, sodium, lithium, etc., are in the treatment of *cerebral disorders from overaction*. The bromides acting on the heart slow its movements, and, on the vaso-motor nerves, diminish the intra-cranial blood-supply. The best results are obtained in the treatment of cases in which there is no anæmia on the one hand, or inflammatory reaction on the other; cases in which the intra-cranial blood-supply is in excess, because the vaso-motor regulating centers are wanting in activity. The most typical representation of this condition is seen in *wakefulness* from cerebral overwork. No clinical fact is more conspicuous than that the bromide of potassium will relieve wakefulness of this kind. The hypnotic action of the bromides is not a certain action like that of chloral, nor like that of morphine under appropriate conditions; considerable mental excitement and an active cerebral congestion may entirely prevent the hypnotic effect. Wakefulness from mental worry, fatigue, unrest of the peripheral nerves (fidgets), and similar causes, will generally be relieved by the bromides. For this purpose a cumulative action is generally desirable, effected by giving a dose of fifteen grains before each meal, and one of thirty grains on retiring. The manner in which the hypnotic action of the bromides is limited by certain states of the intra-cranial circulation is well exhibited in *delirium tremens*. In the condition of nervous excitement and wakefulness which precedes the delirium, and which is known as "horrors," the action of the bromide is most satisfactory; it quiets the restlessness and induces sleep. For this purpose considerable doses are necessary—a drachm every four to six hours. When, however, delirium tremens is fully developed, this remedy is much less efficient, and frequently fails altogether to produce sleep. It is more serviceable in the first than in subsequent attacks of horrors, and its utility diminishes as the structural alterations of chronic alcoholismus increase.

In some cases of *maniacal excitement* the bromides produce excellent effects, but they very frequently fail without apparent reason. In *acute mania* accompanied by heat of head, injected conjunctivæ, and restlessness, refreshing sleep may follow the administration of one full dose; but the remedy fails more frequently than it succeeds. In *puerperal mania* of the sthenic form, with rather quick and full pulse, hot head, and injected conjunctivæ, the author has witnessed excellent results from the use of the bromide of potassium; but it has rather increased the delusions and the depression when the type of the case was melancholic, with systemic weakness and anæmia. A similar experience has been had in the use of the bromides in *hypochondriasis* and *melancholia.* These forms of mental trouble are most usually accompanied by bodily weakness, and are rather increased by the use of the bromides; but it occasionally happens that these agents give an amount of relief afforded by no other drug or combination of drugs. It is impossible to indicate, in the present state of our knowledge, the particular cases in which the bromides may be serviceable, but the author ventures to express the opinion that the state of the intra-cranial circulation, which may be ascertained on ophthalmoscopic examination, will furnish the true guide. It need hardly be observed that the bromides are useless when wakefulness is dependent on pain.

Some kinds of *neuralgia* are much benefited by the bromides. The congestive form of *migraine*, or sick-headache, is generally quickly dispelled by one or more full doses. The form of *migraine* in which it acts almost as a specific is that characterized by a flushed face, throbbing temples, injected conjunctivæ, eyes intolerant of light. The bromides often give great relief in the fugitive nerve-pain of hysterical women; but they are quite ineffectual in neuralgia fixed in a nerve, as, for example, in trigeminal neuralgia, sciatica, etc. The bromide of potassium is often quite successful in *ovarian neuralgia*, and in the nervous unrest which grows out of ungratified sexual instinct in men and women.

Very remarkable results have been obtained by the use of large doses of bromide of potassium in *tetanus.* H. C. Wood gives a tabular statement of fifteen cases which he has collected, in which the bromide of potassium was the chief or the only agent used, and of these but two died. No results equal to this have been achieved by any other agent, not even by Calabar bean. In order to succeed with this remedy it must be given in large doses (ʒj every three or four hours). A combination with chloral is also highly effective, but these agents exert a powerfully depressing action on the heart.

Cases of *strychnine-poisoning* have been reported cured by full doses of the bromide of potassium. One case is narrated by Dr. Gillespie in which three grains of strychnine were taken, and the lethal effects were obviated by one ounce of bromide of potassium in divided doses.

No therapeutical fact is better established than the influence of bromide of potassium over *epilepsy* and *epileptiform seizures.* But the curative power of this agent in epilepsy has numerous limitations. It has been well ascertained that bromide of potassium is most valuable in those cases of epilepsy characterized by frequent and violent convulsive seizures. Epileptiform attacks, dependent on the presence of a tumor or other coarse organic lesion of the brain, are usually suspended by the use of this agent, although the neoplasm is unaffected in its growth and development. It is a curious circumstance that attacks, nocturnal exclusively, are less amenable to the bromide-treatment than those which occur in the daytime.

Cases of the *petit mal,* or epileptoid seizures, in which there is temporary loss of consciousness without convulsion, or with a transient spasm of the facial muscles, etc., are as a rule not so much benefited as are cases of the *grand mal.* Hysterical convulsions (hystero-epilepsy) are benefited by the bromide in the degree in which they partake of the nature of true epilepsy. Simple hysterical convulsions are rarely improved even by a course of this medicine. It has been repeatedly shown, as was first observed by Sir Charles Locock, that the bromides are especially efficacious in cases of epilepsy of sexual origin.

Although the bromide of potassium is less effective in the epilepsy of childhood than of adults, it is an excellent remedy in *infantile convulsions* dependent on reflex irritation. After the removal of the irritation the convulsive attacks may continue, but they can be arrested by the use of the bromides. The cerebral congestion which precedes the convulsive seizure may be relieved by this agent, and the threatened attack averted. The author is convinced that the convulsions which attend tubercular meningitis may be prevented by the bromide, but this agent exerts no curative influence in this fatal malady.

In the present state of our knowledge it is not possible to indicate with any degree of certainty, besides the points mentioned above, the kind of cases in which a successful result may be expected from the bromide treatment. If no improvement be manifest after several weeks of treatment, and if bromism be induced, the case must be regarded as an unfavorable one for this treatment. Brown-Séquard thinks that the cropping out of an "acne-like eruption on the face, neck, shoulders," etc., is an evidence that the bromide is proving curative, and he even asserts that there is "a positive relation between the intensity of the eruption and the efficacy of the remedy against epilepsy." According to Voisin, the abolition of reflex nausea—ascertained by passing a spoon as far back as the epiglottis, without causing attempts at vomiting—is an indication of the successful action of the remedy. Furthermore, he regards the following physiological effects as evidence of curative power: "Hypnotic manifestations, general lassitude, an easy and rapid disappearance of reflex nausea, and antaphrodisiac action."

Certain cases of epilepsy, in which the bromide of potassium fails to afford relief, are greatly benefited by strychnine. From this circumstance it has been concluded that the former agent is most serviceable in cases in which a condition of hyperæmia of the brain exists, and that the latter agent produces the best effects when a condition of cerebral anæmia is present.

Various important considerations are connected with the administration of the bromides in epilepsy. The daily dose required varies from half a drachm to four drachms, the limit of the quantity administered being determined by the effect produced. The occurrence of bromism and the arrest of the seizures are the evidences that a sufficient quantity has been introduced into the organism. According to the author's experience, forty grains of the bromide, dissolved in water and given before each meal, or three times a day, and if required a double dose at bedtime, is an amount of the medicine which it is rarely necessary to exceed. When the convulsive attacks have ceased, a single dose of sixty grains at bedtime will generally suffice; but this result must not be interpreted too favorably, and the remedy discontinued, for an immense experience has now demonstrated that security against a return of the attacks can only be attained by a continuance of the remedy for two or more years after all indications of epilepsy have disappeared. After the continuous use nightly of the remedy for a year, the dose may be so far diminished as to give it on alternate nights. Should the attacks recur after temporary cessation, larger doses are required as a rule.

The long-continued use of the bromide of potassium may produce very serious symptoms of bromism. The remedy must then be greatly reduced in amount or be discontinued, and tonics and restoratives administered until the organism recovers its tone. When there is much susceptibility to the action of the bromides, it is generally better to prescribe the bromide of sodium. This salt is equally effective in epilepsy, while it is much less depressing in its effects. It is not unfrequently desirable to administer iron during a course of bromides. The author has had excellent results from the following: ℞ Potassii bromidi, ℥ j; ferri bromidi, gr. vj; aquæ, ℥ vj. M. Sig.: *A tablespoonful three times a day.* Echeverria has made the observation that taking strong coffee with the meals hinders the development of bromism. The troublesome and very disfiguring acne may be, in part at least, prevented by the conjoined administration of arsenic (three to five drops of liq. potassii arsenitis). Brown-Séquard, with that fondness for complex combinations which he has always exhibited, recommends the following formula for epilepsy: ℞ Potassii bromidi, ℥ j; ammonii bromidi, ʒ ijss; potassii iodidi, ʒ j; potassii bicarb., ℈ ij; i calumbæ, ℥ vj. M. Sig.: *A teaspoonful before each meal, and teaspoonfuls at bedtime.* There is probably no advantage in this bination, and it is execrable as regards taste. It is true somet better results are obtained from a combination of bromides than the bromide of potassium alone. It is always advisable to com the iodide of potassium with the bromides, when there is reaso suspect syphilitic cerebral lesions, or when degenerate changes appear to be taking place.

Vaso-motor disturbances, elsewhere than intra-cranial, are reli by the bromides. "Such symptoms are, for example, sudden nu ness, coldness, deadness, or pricking sensations in one or more lin sudden distressing but indefinable feelings in the epigastrium, al men, or hypogastrium; or sensations akin to rigor, with much anx and palpitation, or 'fluttering,' of the heart. In such cases it ma observed that the local circulation is interfered with; that, for ex ple, the pulse in one arm becomes faltering, irregular in force rhythm, occasionally intermitting, while that in the other arm remain unaltered, and the beat of the heart may maintain its nor character."

The *painful flushings of the face, and the sense of fullness in head*, which occur so frequently at the climacteric period in won may often be removed by the bromides.

Certain of the *respiratory neuroses* are greatly relieved by bromides. *Laryngismus stridulus*, when present, may be suspen by the prompt use of full doses, and the tendency to frequent re rence of the attacks obviated by the steady and continued use of m erate doses of this remedy. It may be combined with chloral: Potassii bromidi, ʒ ij; chloral. hydratis, ʒ ss; syrup. tolu., ℥ ss; aq ℥ jss. M. Sig.: *A teaspoonful every half-hour.* The bromides gre relieve the spasmodic element of *whooping-cough*, but they do not pear to shorten the duration of the disease. A combination such given above, for a child of two years, may be prescribed in whoopi cough during the spasmodic stage, and in proportionally larger qu tity for older children.

In *spasmodic asthma* very great relief is sometimes afforded by use of bromides, but these remedies lose their effect very quicl The best results are obtained from a combination of the bromide the iodide of potassium: ℞ Potassii bromidi, ℥ j; potassii iodidi, aquæ, ℥ iv. M. Sig.: *A teaspoonful in sufficient water every h hour or hour.*

Cough which is merely reflex (stomachal, intestinal, renal, uter ovarian) can usually be cured by the bromides. It is said that a gle of the bromide of potassium will diminish the cough of phth The author has ascertained that it is only occasionally that such a tunate result can be achieved in this way. Such a diminution of the sensibility of the fauces can be produced by a few large doses of the bromide of potassium, that this expedient has been proposed to facilitate laryngoscopy and rhinoscopy.

In certain neuroses of the genito-urinary organs, male and female, excellent results have been obtained by the use of the bromide of potassium. *Abnormal sexual excitement* and *nocturnal seminal emissions* may be checked by this remedy. The condition of plethora is the indication for the bromide. When the sexual organs are much relaxed, the erections feeble, and the seminal fluid watery, especially if there be such a constant stillicidium of semen as to constitute the so-called diurnal losses, the bromide of potassium does harm. The more nearly nocturnal seminal losses approach the physiological type, the more effective the bromides. As they act by diminishing the blood-supply to the erectile organs, it is obvious that they are contraindicated when there is debility, and when the erections are feeble. They prove completely successful when the erections are normal as to character, but teasing and persistent. The various nervous disturbances growing out of unsatisfied sexual desire are quieted by these agents. As a rule, *nymphomania* and *satyriasis* dependent on cerebral lesions are not diminished or prevented by the bromides.

Bromide of potassium, in full doses, has been proposed for the relief of *chordee*. The result is generally disappointing, but occasionally relief is experienced from it. Very large doses (ʒ j every four hours) are necessary.

Menorrhagia, dependent on ovarian irritation, is usually promptly arrested by these agents. Sometimes *metrorrhagia*, even when due to a fibroid, is remarkably improved by their use, but success is not invariable.

Various functional nervous disorders associated with, or dependent on, derangements of the sexual system—for example, such as are grouped together under the term *spinal irritation*—are treated with occasional success by the bromides. It is to be noted, however, that a condition of general anæmia or local spinal anæmia, which usually coexists, is a contraindication to the use of these agents. They are useful in proportion to the degree of plethora present.

Local Uses of Bromides.—*Epithelioma of the face* has been cured by applying to the ulcerated surface bromide of potassium in fine powder. A solution, gr. x—gr. xx to an ounce of water, is a useful application for allaying the itching in *pruritus*, *prurigo*, and similar conditions, and the powder dusted over the surface is an effective remedy for *eczema*, *old ulcers*, etc.

Acidum Hydrobromicum Dilutum.—*Diluted hydrobromic acid.* A liquid composed of ten per cent of absolute hydrobromic acid and ninety per cent of water. A clear, colorless liquid, odorless, having a strongly acid taste, and an acid reaction. Dose, — ʒ ij.

Hydrobromic acid has many of the properties of the bromides can therefore be substituted for the latter in some cases. In the t ment of epilepsy, the acid is far inferior to the bromides. In modic cough it has proved very useful. In *angina pectoris*, or *diac irregularities* due to acidity of the stomach, it is highly us given before meals. The tinnitus, dizziness, and headache cause quinine may be largely diminished, if not wholly prevented, by addition of hydrobromic acid to the solutions containing the for or by giving the latter some time after. The after-nausea and de sion caused by morphine may be obviated by the simultaneous or sequent administration of hydrobromic acid.

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Bromoform.—As respects its chemical constitution bromoform terbromide of formyl, as chloroform is a terchloride of formyl. If the chlorine in chloroform bromine is substituted, the resulting c pound is bromoform. It is a transparent, colorless, oily liquid, having an ethereal odor, a sweetish taste, and a specific gravity more than twice that of chloroform, or 2·9. It is slightly soluble in water, and freely in alcohol and ether. When exposed to the light it becomes brownish in color and bromine fumes are given off. The dose ranges from two minims for an infant to three to five minims from two years up to five, and in the same proportions for older children, and for adults ten to fifteen minims, three or four times a day. It is best administered to children in sirup, to adults in capsules.

As regards *physiological action*, bromoform corresponds closely to the other bromides. It acts on the reflex centers to inhibit their functions, and also on the centers of conscious impressions to induce sleep and insensibility to pain. It is, therefore, an anæsthetic, like its congener, chloroform, but it is too dangerous to be so utilized. It lessens the depth and frequency of the respiratory movements, and also the force and tension and rate of the pulse, ultimately in sufficient quantity paralyzing both.

Bromoform is not actively toxic. Some cases of poisoning by accident and overdoses have been reported, but they were restored by the use of stimulants and the antagonists of the cardiac and respiratory depression (Stepp).

The indications for the therapeutical employment of bromoform are the same as for the alkaline bromides, but experience has shown that there is a special field for its powers. The evidence of its utility in the treatment of *whooping-cough* is conclusive. Stepp, who was the first to make use of this remedy, reports on one hundred cases in which it proved to moderate the violence and shorten the duration of the disease without a failure. The duration of the treatment varied somewhat, but it ranged from two to four weeks. The number of paroxysms began to diminish after a few days' treatment. Löwenthal, assistant in Senator's clinic in Berlin, also tried it in one hundred cases of whooping-cough, and with most gratifying results. The first symptom to yield was the vomiting, and in three to five days the nosebleed ceased, and the paroxyms of coughing rapidly lessened in number and severity. Schippers, who prescribed the remedy in no less than two hundred and fifty cases, concludes that bromoform in the indicated doses is free from harm, that it diminishes the number and severity of the paroxysms, stops the vomiting and the nasal hæmorrhage, and materially shortens the duration of the disease. Dr. Fischer, of New York, also reports favorably on the effects of bromoform in whooping-cough, which he maintains is the best remedy hitherto proposed for the relief of this disease.

Bromoform is an admirable remedy for ordinary *coughs* from catarrhal affections of the broncho-pulmonary mucous membrane. In combination as follows it is now much prescribed by French physicians: ℞ Bromoformi, ʒ ij; codeinæ sulph., gr. viij; acet. scillæ, ℥ ss.; syr. tolu, ℥ iijss. M. Sig.: A teaspoonful every four hours for an adult. For a child, the quantity of bromoform and codeine should be one fourth to one eighth of these amounts respectively.

Bromoform is an effective remedy for the relief of the cough of phthisis. It may be combined in the form given below, and used by inhalation as a remedy for the *cough of phthisis:* ℞ Bromoformi, ʒ j; pyridin., ʒ ij; ethyl. bromidi, ʒ v. M. Sig.: Ten to twenty drops by inhalation. The administration may be made by dropping on a handkerchief, or on a sponge placed in a small funnel or in a vial. The patient should be directed to inhale the vapor frequently if the cough is troublesome, or several times a day if an impression is to be made on the local disease. There is reason to believe that this combination approaches the dignity of a curative agent, since under its use the *bacillus* is inhibited, even destroyed.

Bromoform has also been used with more or less success in other spasmodic diseases, as *asthma, singultus, laryngismus stridulus,* etc. A severe attack of asthma may be aborted by the subcutaneous injection of five minims. As it is not irritating to the tissue, this procedure may be resorted to without risk of subsequent mischief, besides the immediate distress accompanying the subcutaneous injection of an ethereal compound, which, however, is of short duration.

The author has had good effects from its administration in cases of *headache,* in *vertigo* from reflex causes, and in various abnormal sensations in the head belonging to neurasthenia. In certain cases of intestinal catarrh with reflex vertigo and occipital headache it has apparently done much good. It well deserves a trial in *hepatic colic,* in *renal colic,* and in the colic-like attacks that occur during the course of chronic intestinal catarrh.

As a remedy having the properties of a bromide, and possessing by combination with formyl certain sedative powers, bromoform is a promising expedient for *epilepsy,* and already some experiences have shown it to be well worthy of attention. The more recent the epileptic seizures, the more promising the remedy. It is also an efficient remedy in the treatment of *excitement in the insane.* Dr. Angrisani employs for this purpose a solution of bromoform in glycerin flavored with oil of cinnamon, and begins with a dose of fifteen minims, increased to thirty minims if desired. The sedative effect is rapidly manifested, and no unpleasant after-effects have been observed except some diarrhœa, which was readily controlled. It follows from these observations that bromoform may be utilized in place of the bromides of the alkaline bases in cases in general to which these are applicable.

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Bromal.—In this form bromal is a heavy liquid, oily in consistence, and of a pungent flavor and taste. In chemical constitution it is *tribrom-acetaldehyd.* On the addition of water it forms a hydrate, and as thus constituted is employed in medicine.

Bromal Hydrate occurs in white crystals, deliquescent on exposure, pungent in taste, and having a chloral odor. It is soluble in water and the ordinary menstrua, and is incompatible with alkaloids. Dose, gr. ij to gr. x, in solution.

Bromalin.—*Brom-ethyl-formin.*—This occurs in laminated crystals, colorless, or in a whitish crystalline powder. It is soluble in water, and can be administered in capsules or wafers, or in an ordinary powder; the dose ranges from gr. xv to ℈ij.

Bromamide.—*Tribromaniline Hydrobromate.*—This is a colorless, odorless, and tasteless substance occurring in needles. Readily volatilizes. Dose is from three to ten grains, several times a day.

We have in the last four products combinations in which the effects of bromine are modified and enhanced. Bromal is not employed in that form, but as bromal hydrate, and has had good effects in insomnia, chorea, epilepsy, and similar nervous affections. Bromalin, the third member of the group, has been brought forward more especially as a substitute for potassium bromide in the treatment of epilepsy. It may be used more widely on the same ground, and in the various maladies to the treatment of which potassium bromide has hitherto been applied. Bromamide has been utilized in rheumatic fever, chronic rheumatism and neuralgia, and as an analgesic and antipyretic of considerable activity.

Formanilide (phenylformamide) has affinities in composition and mode of action with bromoform. It is obtained by combining with the aid of heat aniline with ethyl formate. It crystallizes in the form of prisms and is freely soluble in water. A twenty-per-cent solution dropped on the tongue causes a strongly pungent sensation, which is followed by analgesia and pallor of the mucous membrane, and this anæsthetic effect is maintained from one to two hours. Preisach has also tested its action on the mucous membrane of the larynx, and complete analgesia was induced by it in a few minutes, remaining for several hours. Dr. Meisels has also experimentally ascertained that the mucous membrane of the urethra is similarly affected by it. By Touszk it has been found to possess the same antipyretic and analgesic action as the most valuable members of the fatty and aromatic series of synthetical products. Some transient lowering of the heart's action and some slight systemic depression have been observed.

AGENTS WHICH DEPRESS THE MOTOR FUNCTION OF THE SPINAL CORD AND SYMPATHETIC.

Conium.—Hemlock. The full-grown fruit of *Conium maculatum* Linné (Nat. Ord. *Umbelliferæ*), gathered while yet green. *Ciguë*, Fr. *Schierling*, Ger.

Extractum Conii Alcoholicum.—Alcoholic extract of conium Dose, gr. j—gr. v.

Extractum Conii Fluidum.—Fluid extract of conium. Dose ♏ ij—♏ v—♏ xl.

Tinctura Conii.—Tincture of conium. Dose, ♏ x—ʒ j. (Not official.)

The preparations of conium are very uncertain in strength. It is pretty well established that the extracts are nearly, if not quite, inert. The best preparations are the fluid extract and alkaloid.

Composition.—The special powers of hemlock are due to a peculiar alkaloid (*conine*). This is an oily, limpid liquid, having a strong alkaline reaction, a peculiar odor resembling the urine of mice, and a specific gravity of 0·88. It probably exists in the plant in the form of the malate; but, by some authorities, the acid with which it is combined is supposed to be an acid peculiar to conium, the *coneic acid*. Conine is associated with ammonia, and another crystallizable alkaloid, *conhydrine*.

Conine is quickly decomposed by heat. Exposed to the air, it is soon converted into a brownish resin, and becomes inert. Hence it is that the preparations of conium possess but little activity, and are so frequently, indeed entirely, wanting in physiological and therapeutical effects. It is better, therefore, to administer the alkaloid, which, being soluble in alcohol, may be administered in that menstruum, or it may be converted into an acetate and dissolved in a mixture of alcohol and water. It is to be noted, also, that different specimens of conine differ remarkably in activity; hence, whenever a new preparation is begun, the minimum dose should be first administered until its real power is ascertained (Burman).

Conine.—Dose, gr. $\frac{1}{60}$—gr. $\frac{1}{20}$—gr. $\frac{1}{10}$, or in minim-doses from ♏ $\frac{1}{10}$—♏ ij. Half a minim of conine (pure) is about equivalent in activity to ℥ j of the best succus conii. The chlorhydrate and especially bromhydrate of conine are greatly to be preferred, not only to the pure alkaloid, but to any of the preparations of conium. The bromhydrate crystallizes in the form of colorless, prismatic needles, which are freely soluble in water and also in alcohol, have but little taste, and no odor (Mourrut). The dose of this salt ranges from $\frac{1}{12}$ of a grain to $\frac{1}{4}$, $\frac{1}{2}$, even 1 grain. It is not actively toxic. By reason of this fact, its freedom from a disagreeable taste or odor, and its solubility, the bromhydrate is a most desirable preparation for administration, either by the stomach or hypodermatically.

ANTAGONISTS AND INCOMPATIBLES.—The caustic alkalies and tannic acid are chemically incompatible. Physiologically considered, the actions of conium are antagonized by nux-vomica and its alkaloids strychnine and brucine, by picrotoxin, and the tetanizing agents in general.

SYNERGISTS.—Gelsemium, tobacco, veratrum viride, aconite, methyl-strychnium, hydrocyanic acid, and curara, increase the action of conium.

PHYSIOLOGICAL ACTIONS.—The preparations of conium possess a considerable degree of acridity, and are therefore apt to produce gastric irritation, nausea, and vomiting. These results sometimes follow the subcutaneous injection of conine. The active principles readily diffuse into the blood. What changes, if any, they induce in the blood are quite unknown. It is probable that they limit the power of the red blood-globules to convey oxygen to the tissues on which they have a selective action—the motor nerves.

When an active dose of conine is administered, weakness of the legs and a sense of weight and fatigue of these members are first experienced. The eyelids become heavy and droop somewhat, and double vision, or confused vision, a feeling of torpor of the mind, and giddiness, follow. Speech is also affected as respects vocal utterance, but the memory for words and the faculties of mind generally are unimpaired. When the dose is a lethal one, paralysis of the voluntary muscles—first of the inferior extremities—ensues; there is considerable vertigo, the mind is torpid and indifferent but not perverted, speech and vision are lost, the respiration becomes labored and slow from paralysis of the respiratory muscles, and death occurs from asphyxia, the action of the heart continuing until after respiration has ceased. The mind remains unclouded to the last, except when delirium ensues from carbonic-acid poisoning. Convulsive movements generally occur in animals from retention of carbonic acid in the blood, and in man sometimes local convulsive movements. Sensation is unaffected until near the close, but a subjective sense of numbness is experienced in the feet and legs, without actual impairment of the functions of the sensory nerves. The body temperature is decidedly lowered, and in a direct ratio to the amount of the paralysis.

The physiological effects of conine, even when produced by decidedly large medicinal doses, are hindered if not entirely prevented by active exercise. When the muscular weakness, the heaviness and sense of fatigue in the legs are first experienced, if resisted and muscular movements are carried on, these sensations disappear, and the whole duration of the physiological effects is much shortened.

The action of conine is, primarily and chiefly, on the end-organs of the motor nerves; the nerve-trunks next lose their excitability, and by an extension of the paralysis the spinal cord is at last involved. The muscular irritability remains unaffected. According to M. Verigo, the paralysis proceeds from the spinal cord, outwardly, to the terminal filaments of the motor nerves. But it is probable that this experimenter operated with a preparation of conine containing methylconium, which has been shown, by Crum Brown and Fraser, to affect first the motor columns of the spinal cord.

No constant and characteristic *post-mortem* appearances seem to be produced by conine. The left cavities of the heart are found empty, and the right distended, but these are products of the mode of dying, and are not directly due to the action of the poison. The blood is generally fluid, and the coagula are soft.

Elimination takes place by various channels, chiefly by the kidneys. Conine has been found in considerable quantity in the liver, lungs, and spleen.

That the conium of our time was employed by the ancients, can hardly be doubted by any one who will read the account of the death of Socrates from the Athenian state poison. This remarkable story, which has descended to us in Plato, bears all the indications of verisimilitude, and its delineation of the effects, as the symptoms successively manifested themselves, are just as we see them now, in the action of conium on animals, and, as Harley has described them, as occurring in his own person. Socrates continued his sublime discourse after the poison had been swallowed, thus showing that his mental powers had not been clouded—not certainly till near the end, when, as we now know, carbonic-acid narcosis comes on. Plato described the slowly-developing paralysis, beginning below and ascending—the mental powers of Socrates remaining unimpaired until near the end, when his commands were laid on his disciples to sacrifice a cock to Æsculapius, which was a return to the superstitions of the age, after having condemned them in the course of his ethical disquisitions before the youth of Athens, for which he now underwent the extreme penalty of the law.

Therapy.—Formerly the preparations of conium were much used for a supposed discutient or resolvent action in *glandular enlargements*, and in certain *kinds of tumors*. But, since it has been shown that the preparation chiefly employed for this purpose (the extract) is practically inert, the supposed cures effected in this way are justly regarded as examples of the *post hoc*. Influenced by the same considerations, conium was supposed to have an alterant and anodyne action in *cancer*. But, since, in the progress of physiological research, it has been shown that conium affects the motor and not the sensory nerves, it is no longer employed to relieve the pains, or to arrest the growth and diffusion, of cancer. It is right to add, however, that able practitioners hold that the discutient and resolvent powers of conium are well established in clinical experience (Stillé).

The true uses of conium are those deduced from a consideration of its physiological actions. As it lowers the functional activity of the motor nervous system, it is indicated in those cases of disease in which motor activity is in excess. Very valuable results have been obtained by the use of *conine* in *mania*, administered with the view of subduing excessive motor excitement. Its real utility consists in quieting muscular agitation, and thus preventing emaciation and maniacal exhaustion. It is considered to be most suitable to the treatment of *acute mania*, without organic brain-lesion (Burman). The dose required for this purpose is ♏ ss—♏ iij, or subcutaneously, commencing with one tenth of a minim, and gradually increasing it until some characteristic physiological effects are produced.

The succus conii has been used by Harley and others with success in *chorea*. The special object for which it is used in this malady is to quiet the excessive muscular agitation ; but, in order to accomplish this result, a sufficient quantity must be administered to produce distinct physiological effects. To quiet muscular agitation is not alone sufficient to cure chorea ; a suitable hygiene, proper alimentation, and restorative agents, are indispensable. Some cases of *paralysis agitans* are remarkably benefited by conium, but it is of little avail in cases of *sclerosis*, or when important structural alterations have occurred. Conine is certainly indicated in *tetanus*, *hydrophobia*, and *strychnine-poisoning*, but hitherto it has not succeeded, probably because inert preparations were employed. The author has ascertained that in animals conine rather hastens than retards the lethal effects of strychnine.

In *whooping-cough*, *asthma*, and *laryngismus stridulus*, good effects have been obtained by the use of conium, carried to the point of inducing its characteristic physiological effects. *A priori*, the best results might be expected from the use of conium in *epilepsy*, but it is by no means comparable to the bromides. According to Echeverria, conium is serviceable in those cases of epilepsy "attended by cerebral derangement and vertigo."

The state of *blepharospasm*, which accompanies *strumous ophthalmia*, is relieved by considerable doses of conium. It is necessary in the treatment of this, as of other motor disorders, to give a sufficient quantity of conium to produce sensible physiological effects.

The subcutaneous injection of conine may be practiced instead of the stomach administration, in all of the forms of disease for which this remedy is prescribed. By Burman this mode of administration has been practiced with much success in the treatment of *acute mania ;* by Pletzer, in *asthma ;* by Erlenmeyer, in *emphysema* and *angina pectoris ;* by Lorent, in *pneumonia* and *pleuritis ;* and by Eulenburg, in *blepharospasm*. A marked decrease in the pulse-rate, and in the tem perature, has been observed to follow the hypodermatic injection of conine in these diseases. The rational indication for the use of conine in pneumonia and pleuritis is, to give the organs physiological rest by inducing a paretic state of the respiratory muscles.

A solution of bromhydrate of conine is greatly preferable to any form of the alkaloid, for all purposes, but especially for subcutaneous injection. The following will prove useful: ℞ Conine bromhydratis, gr. viij; aquæ, *vel* aquæ chloroformi, ℥ j. M. Sig.: Ten minims contain one sixth of a grain. As Tiryakian and also Tuloup have shown, the effects of this agent decline by repetition, and hence the dose must be increased every few days. Two doses every twenty-four hours will usually be sufficient to maintain a constant effect. By the authors above mentioned, by Dujardin-Beaumetz, Prevost, Rochefontaine, and others, it is asserted to be very effective in spasmodic affections, especially of the respiratory organs—in whooping-cough, asthma, dyspnœa, laryngismus stridulus, spasm of the glottis, hiccough, etc. It has been used with success in tetanus by Chisolm and by Cory.

Conine and Morphine.—The effects of conine are in every way heightened by morphine. These agents have been very successfully employed in acute mania, conjointly administered subcutaneously. "Conine acting on the purely motor centers, in a sedative manner, and morphine acting in a similar way on the sensori-motor and ideo-motor centers, it follows, as a fair corollary, that the combination of the two, in subcutaneous injection, should lead to effects directly antagonistic to the condition of maniacal excitement; and, such being in fact the case, they may be thus used together with very great success in the treatment of mania." When *nerve-pain* and *muscular spasm* coexist, the best results may be expected from the combined administration of morphine and conine.

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Curara, or Woorara.

History.—There are no official preparations. The substances known under this name vary much in purity, and differ in origin. True curara is a poisonous substance, prepared by the Indian tribes of certain districts of South America, and known under the names *woorara*, *urari*, *wurali*, etc. A specimen examined by Mitchell and Hammond consisted of two distinct preparations named respectively *carroval* and *vao*, the former more closely corresponding to the European specimens. Curara is obtained for the most part from several plants of the *Strychnos* family, as *Strychnos toxifera*, *S. cogens*, and from *Paulinia cururu*. An extract from these plants, it is supposed, is mixed with the venom of certain poisonous reptiles, and possibly with other animal substances. As the arrow-poison of different tribes differs not only in strength, but in the character of the effects produced by them, it is certain that they are derived from different sources. That which is now obtained in commerce as curara, and which agrees in the main with the description of Bernard, is the substance referred to in this article.

Composition.—Curara occurs in small, irregular masses, of a dark-brownish color, somewhat slimy, and looking like a dried vegetable extract. The mass is in part soluble in water, and the undissolved residue is composed, for the most part, of starch-granules, vegetable cells, oil-drops, and other vegetable structures (Mitchell and Hammond). The existence of an alkaloid in curara had been suspected by Boussingault, but it was not actually discovered until 1865, when it was isolated by Preyer (curarine). The estimates formed of its activity vary: by Preyer it was held to be twenty times stronger than the crude drug, but by Beigel only six times; but these differences are readily accounted for in the varying qualities and activity of curara.

Curarine, one of the alkaloids, is crystallizable, deliquescent, and forms with acids salts, which are also crystallizable. The dose will range from $\frac{1}{100}$ gr. to $\frac{1}{40}$ gr. by the stomach—from $\frac{1}{200}$ gr. to $\frac{1}{100}$ gr. when administered subcutaneously. A larger quantity may be necessary when distinct physiological effects are to be produced.

Another alkaloid has since been discovered by Böhm, and to this he has assigned the name *curine*.

The dose of woorara or curara, the crude drug, will range from $\frac{1}{20}$ gr. to $\frac{1}{6}$ gr. It is desirable to try on some inferior animal the activity of any new specimen before using it on man.

Antagonists and Incompatibles.—As curara is a paralyzer, it is antagonized by those agents which act in the opposite manner on the spinal cord. From the physiological standpoint, strychnine and atropine are appropriate antagonists, opposing the tendency to death by failure of respiration. Remarkable results have been obtained in animals by artificial respiration. An animal will recover from twice the fatal quantity, if respiration be kept up until elimination occurs, which is speedy. As in the case of the other alkaloids, curarine is destroyed by the caustic alkalies.

Synergists.—The paralyzers in general, especially the respiratory group, promote all of the actions of curara.

Physiological Actions.—The taste of curara is bitter. Applied to the unbroken integument, it is not absorbed; but swallowed, it slowly diffuses into the blood, and produces characteristic effects. Vulpian finds that it is absorbed more rapidly when injected into muscular masses than when simply thrown under the skin. According to the observations of Voisin and Liouville, made on man, the salivary, nasal, and lachrymal secretions are increased. It is probable that the gastro-intestinal secretions are also promoted. The rate of diffusion into the veins from the stomach varies, but it takes place in from twenty minutes to a half-hour; but even a longer time than this may be required. The action of the heart increases; the pulse rises a number of beats and may be dicrotic; the temperature ascends two to three and a half degrees, and the respirations are accelerated, four to eight times per minute being added to the usual rate. Voisin and Liouville ventured on the exhibition of larger doses with the following result: the symptoms began by a more or less violent chill; the heart beat rapidly, reaching 140, and the pulse became weak; the respiration was labored and sighing; the temperature rose, and double vision, sometimes with mydriasis, sometimes with myosis, set in. The legs became weak, coördination was destroyed, and the vertical position could not be maintained. The mind continued undisturbed. The paralysis disappeared after a short time, but a sense of fatigue persisted in the limbs for some hours. The increased temperature was accompanied by the usual symptoms of fever—there were, besides the accelerated pulse and respiration, headache, thirst, and perspiration.

It was by means of curara that Bernard demonstrated the existence of contractility as an independent endowment of muscular tissue. Curara, by poisoning the end-organs of the nerves in the muscles, separated these organs, and thus permitted a study of the agency of each. In all classes of animals, as in man, curara induces paralysis of movements: locomotion, the erect posture, breathing, finally the heart's action, are arrested. The paralysis induced by curara is not due to an abolition of the excitability proper to the motor nerve-trunks, but to a modification set up in the terminals of the intra-muscular nerves. This fact is proved by the well-known experiment of Bernard, repeated by Kölliker, Zeleuski, Vulpian, and numerous other experimentalists, in which a frog is paralyzed by curara in all parts of the body except one limb which has been ligatured to prevent the access of the poison to it. The muscles of the unpoisoned limb react normally to stimulation, to the will, and to reflex impressions from distant parts. The muscles of the poisoned parts of the body act on direct stimulation, but not by the will nor by any direct or reflex excitation conveyed by the nerve. The paralysis must therefore be due, as above stated, to the effect of the poison on the terminals of the nerve in the muscular tissue. As movements can be induced in the muscles of the unpoisoned limb by irritation of the skin at a distant point, it is clear that the sensory nerves and the reflex function of the spinal cord continue active. It has been abundantly demonstrated that in curarized animals the spinal cord preserves its functions for a long time. If, however, a large quantity of the poison is administered, and a fatal result prevented by artificial respiration, the excitability of the cord is at first increased but afterward paralyzed (Von Bezold, Vulpian, etc.). The motor and sensory nerve-trunks are also finally affected, but this is a secondary action, and ascertainable in curarized animals only by maintaining artificial respiration a sufficient length of time. It follows, then, that all parts of the nervous system are ultimately paralyzed. The action begins in the end-organs of the motor nerves, and then gradually extends to all parts, if the dose is large enough and life is maintained by artificial respiration.

Curara also acts on the accelerator nerves of the heart, at first stimulating and afterward paralyzing them. The action of the heart is increased, also, by the paralyzing effect of curara on the terminals of the pneumogastric, thus removing the inhibition. So decidedly is the vagus affected by full doses of curara, that galvanic irritation does not arrest the movements of the heart (Von Bezold). Notwithstanding the increased action of the heart, the blood-pressure is lowered by curara, due doubtless to a paralyzing action on the organic muscular fiber and consequent dilatation of the vessels. The effect of curara on the sympathetic is variously interpreted. According to Vulpian, the iris contracts on changes in the amount of light falling on the retina in curarized animals; the pupils dilate on faradization of the skin; dilatation of the vessels of the posterior members and an elevation of temperature take place in a curarized dog on faradizing the central portion of the corresponding sciatic; very energetic reflex contractions of the stomach, intestines, and bladder are obtained in curarized animals by faradizing the skin of different regions of the body (Vulpian). These facts indicate that curara does not destroy but rather stimulates the functions of the sympathetic. Curara acts on the lymph-vessels of frogs. According to Tarchanoff, the liquid which accumulates during curarization grows richer in leucocytes; also the blood contained in the vessels becomes more concentrated, the relative proportion of red globules being increased. As the accumulation of leucocytes takes place in the lymph-sacs, there is a corresponding diminution of them in the blood. These changes are due to the paralysis of the peripheric vessels (Tarchanoff).

Curara, as has been stated, produces an obvious rise of temperature in the extremities. This is supposed to be due to paralysis of the peripheral vessels. In the interior of the body, however, there ensues an equally constant decline of body-heat (Tscheschichin, Röhrig und Zuntz). This lowering of the central temperature is due to the loss of heat at the periphery by the cooling of the blood detained in the superficial vessels.

Bernard long ago ascertained that curarized animals became diabetic. It seems probable that this result is due to the paralysis of the vessels of the liver. On the other hand, Bock and Hoffmann have apparently demonstrated that the production of glycosuria is the result of increased activity of the liver. It may be due to the fact that the sugar formed does not undergo oxidation, for Jolyet has ascertained that in curarized animals the excretion of carbonic acid is much below the amount in health. By reason of the changes in the vascular supply, curara affects the functional activity of various organs. The increased production of saliva, and of the nasal and intestinal secretions noted at the outset, is due, there is little doubt, to this fact.

The elimination of curara takes place chiefly by the kidneys, but some escapes with the fæces (Koch). The urine of a curarized animal will poison another animal, and this may be repeated to several subjects. The retention of the urine charged with curara, in the bladder, will continue the effects of the poison by reabsorption. This statement has been the subject of considerable controversy. It has been denied that the mucous membrane of the bladder possesses the power to absorb again into the circulation poisons dissolved in the urine in the process of excretion. Brown-Séquard appears to have been the first to prove, by direct experiment, that alkaloids could be thus absorbed, and some recent observations have confirmed the accuracy of his experiments. In respect to curara, as to other organic alkaloids, when poisoning occurs, it is an obviously proper expedient to keep the bladder empty, if necessary, by catheterization.

THERAPY.—The applications of curara to the treatment of disease follow from the results of the physiological study. Being a motor and not a sensory paralyzer, it is adapted to the treatment of *muscular cramp and spasm*. It is one of the remedies employed against *strychnine-poisoning*, and although from the theoretical standpoint such treatment may seem proper, yet in actual practice it has not succeeded. That a remedy obtained from members of the strychnos family, and a paralyzer in action, should antagonize strychnine, is a remarkable fact. In the process of preparation employed by the Indians, it is in a high degree probable that *methyl strychnium* is formed, and this substance, as was originally shown by Crum-Brown and Fraser, is a paralyzer, and acts precisely like curara. Curara has been used with a limited measure of success in *tetanus*. In the successful cases—for example, that narrated by Mr. Spencer Wells—large doses were administered. According to the statistics of Demme, of twenty-two cases of tetanus treated by this agent, eight recovered. Other methods have certainly succeeded better. Two cases of *hydrophobia* have been reported in which a cure followed the use of curara. One of these, reported by Dr. Watson, was examined, and the diagnosis confirmed by Dr. Flint, of New York. The first dose was $\frac{1}{16}$ gr., and subsequently $\frac{1}{6}$ gr. and $\frac{1}{8}$ gr. were given. The value of this statement is impaired by the fact that the different specimens vary so much in activity. M. Vella has successfully treated a case of tetanus by cutaneous absorption of the agent; but the usual mode of administration has consisted in the subcutaneous injection. This subject, as M. Vulpian has well said, has lost its interest since the discovery of the utility of chloral. It is in a high degree probable, however, that curara would be greatly more successful if it were pushed in these cases to obtain its full physiological influence, and the complete suspension of the spasms.

By Voisin and Liouville curara has been extensively employed as a remedy for *epilepsy*. The facts already mentioned in regard to the action of this agent in producing febrile phenomena were obtained from the experiences with epileptics. They find that attacks may be prevented, and the condition of epileptics much improved, by the timely administration of this remedy.

It has proved useful in *chorea*, in *tic-douloureux* (Beigel, Du Cazal), but other remedies are doubtless better.

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Gelsemium.—Yellow jasmine. The rhizoma and roots of *Gelsemium sempervirens* (Linné) Persoon (Nat. Ord. *Loganiaceæ*).

Extractum Gelsemii Fluidum.—Fluid extract of gelsemium. Dose, ℳ ij—ℳ x.

Tinctura Gelsemii.—Tincture of gelsemium. Dose, ℳ v—ℳ xx. The so-called *gelseminine* is obtained by evaporation of the tincture, and is a very uncertain preparation; the dose is gr. ss—gr. ij. It is only used by the eclectic practitioners.

Disappointment is frequently experienced from the use of gelsemium preparations, owing to the fact that they are made from the dried root. In the process of drying, even spontaneously, the alkaloid disappears. The most trustworthy preparations are the official, prepared conscientiously from the fresh root.

Composition.—Gelsemium contains a very powerful alkaloid—*gelsemine* or *gelsemina*—and *gelsemic* or *gelseminic acid*, by some said to be identical with *æsculin*; but Wormley has shown the fallacy in the evidence on which this statement was based, and Fredigke's account of gelsemic acid agrees with Wormley's in all essential particulars. It contains also an acrid resin, volatile oil, gallic acid, a yellow coloring-matter, besides some other unimportant ingredients.

Gelsemine.—In its pure state gelsemine (gelsemia) is a colorless, odorless solid, having an intensely persistent, bitter taste. It has strongly basic properties, completely neutralizing the most powerful acids, forming salts of which the sulphate, nitrate, chloride, and acetate are freely soluble in water (Wormley). Dose, gr. $\frac{1}{60}$—gr. $\frac{1}{20}$.

Antagonists and Incompatibles.—The caustic alkalies and tannic acid are chemically incompatible. As respects the physiological actions, gelsemium is antagonized by the diffusible stimulants, by alcohol, ammonia, opium, digitalis, etc. The lethal effects are best treated by emetics, warmth, alcoholic stimulants, by faradization and artificial respiration, by morphine subcutaneously, and, according to Fredigke, by the tincture of *xanthoxylum fraxineum*.

Synergists.—Conium, physostigma, tobacco, opium, etc., when administered with gelsemium, increase its effects in the whole sphere of its physiological activity.

Physiological Actions.—The preparations of gelsemium have a bitter and somewhat aromatic taste, and a narcotic odor. They do not produce gastric irritation. The active substance, being crystalloidal, diffuses into the blood with facility. In moderate doses, but sufficient to produce decided physiological effects, gelsemium causes a feeling of languor and mental calm, slowing of the action of the heart, drooping of the eyelids, dilatation of the pupil, and some feebleness of muscular movements. In larger doses the physiological effects are as follows: vertigo, double vision, amblyopia, paralysis of the levator palpebræ so that the upper eyelid can not be raised, dilated pupil, labored respiration in consequence of a paretic state of the respiratory muscles, slow and feeble action of the heart, great muscular weakness, and sensibility to pain and touch much reduced. These effects are produced in about a half-hour after the stomach administration, and last two or three hours, when they subside. When lethal doses are taken, the above-described symptoms occur in a more intense degree. The gait is at first staggering, but the power of muscular movement soon ceases, and a sense of numbness diffuses over the body. The eyelids close (paralysis of the levator), the pupils dilate widely, vision is lost, and the pupils cease to respond to the stimulus of light. The lower jaw drops, and the power of speech is lost in consequence of paralysis of the muscles of the tongue. The respirations are labored, shallow, and irregular ; the action of the heart weak, feeble, and intermittent. Generally the skin is covered with a profuse perspiration, but no other evacuation takes place. Death occurs from asphyxia, and the action of the heart ceases after the respiratory movements. Consciousness is preserved until near the close, and until carbonic poisoning ensues. In one instance (Wormley) extreme restlessness was noted, but generally there is a condition of calm, a soporose state, or the unconsciousness of carbonic-acid narcosis, and convulsions never occur.

The author's investigations have demonstrated that gelsemium is a paralyzer of motility and sensibility ; that sensibility is first affected in cold-blooded animals (frogs), and afterward motility, and that in warm-blooded animals the motility is affected before sensibility. As respects the seat of the action, the author has ascertained that the end-organs of the motor nerves, and the nerve-trunks, do not lose their irritability, and that the muscular contractility is unimpaired. "Its paralyzing effect is due to its action on the motor center, and not to an action on the peripheral nerve-fibers. It acts also on the sensory portion of the cord, producing at last complete anæsthesia ; but this effect in warm-blooded animals, and in man, is toxic only, and follows the paralysis of the motor functions." Applying the precise observations which are made on animals to the explanation of the lethal effects which have occurred in man, we are conducted to the following conclusions : the disorders of voluntary movement, and the more or less complete paralysis of the motor and of the sensory functions, are due to the effects of gelsemium on the motor and sensory portions of the cord, the functions of the sensory columns resisting longer the action of the poison. The labored respiration is due to the paretic state of the respiratory muscles, especially of the diaphragm. The depressed action of the heart is probably secondary to the diminished respiration movements, which produce this result by impeding the flow of blood through the pulmonary capillaries. The dilated pupil, the double vision, the ptosis, are due to paralysis of the third pair.

In rabbits and cats gelsemium, in lethal doses, affects motility in a very remarkable manner : when the paralyzing effects are becoming manifest—first in the fore extremities—these animals perform a series of backward movements, in which sometimes a complete backward somersault occurs. In pigeons, general muscular tremors precede the backward movements. No corresponding acts have taken place in the fatal cases observed in man. A very considerable reduction of temperature occurs from lethal doses in warm-blooded animals.

The author's experimental observations on the physiological actions of gelsemium have since been fully confirmed by Ott, by Ringer, and by O. Berger, in an elaborate series of investigations. The study of Ringer and Murrell is a model of a research of this kind.

THERAPY.—Gelsemium is indicated in those maladies in which an exaltation of function has taken place in the motor and sensory spheres of the nervous system. Several cases of *tetanus* have been reported cured by this remedy; but it is impossible to say whether these were examples of *post hoc* or *propter hoc*. *A priori* it might be expected that gelsemium would prove serviceable in this disease, because its action on the spinal cord is opposed to that which takes place in tetanus. In strychnine-poisoning in animals, however, the tetanic spasms are not prevented by the administration of gelsemium. In *mania, with great motor excitement and wakefulness*, this remedy is more useful than conium. To bring about the best results from its administration, doses of sufficient strength must be given to produce definite physiological effects, viz., dilated pupil, drooping of the eyelids, and a feeling of languor. In the condition of "horrors" from alcoholic excess, in simple *wakefulness*, in the *insomnia* which results from over-excitement and too great physical activity, cures are not unfrequently obtained by the use of gelsemium. In the *inflammatory affections of the meninges*, and in *cerebro-spinal meningitis, sporadic or epidemic*, with a decided febrile reaction, this agent is extremely useful in small doses (♏ v of fluid extract), repeated every two hours so as to maintain a uniform physiological effect.

Gelsemium has been used with success recently in the treatment of *neuralgia of the fifth nerve*, but the good effects of the remedy in the painful affections of the fifth nerve are not always manifest (Berger). Cases cured by this remedy were, doubtless, not instances of tic-douloureux, but nerve-pain caused by cold, rheumatism, or temporary excentric irritation. *Intercostal neuralgia, sciatica*, and especially *myalgia*, are frequently cured by this agent (Jurasz); but considerable doses are necessary—from five to twenty minims of the fluid extract every three hours until the characteristic drooping of the eyelids, dilatation of the pupil, and muscular languor, manifest themselves.

In *convulsive* or *spasmodic cough*, gelsemium often affords remarkable relief. It is beneficial in the spasmodic stage of *whooping-cough, reflex cough from irritation of the laryngeal nerves, the irritative cough of phthisis with scanty expectoration*, and the *nervous cough* of hysterical subjects. In some cases of *spasmodic asthma* great relief is afforded by gelsemium, but, as is the case with all other remedies for asthma, it frequently fails and loses its good influence even in those cases in which it was at first successful.

The author has witnessed excellent results from the use of gelsemium in *acute inflammations of the lungs and pleura.* In *pneumonia* it affords rest by diminishing the activity of the respiratory function; it allays cough, and, by depressing the cardiac movements, it lessens stasis of the pulmonary capillaries and lowers the temperature. It is better to give medium doses (♏ iij—♏ v of the fluid extract), every two hours, to maintain a constant effect within the limits of safety. It favors, when exhibited in this way, the occurrence of an early crisis, and assists in the production of one critical evacuation—the sweat. A similar mode of administration should be pursued in *pleuritis*, in which its use is equally rational and effective.

Very great relief is afforded by the use of gelsemium in certain *pelvic disorders* in women. There is no more generally-useful medicine in *ovarian neuralgia.* The pains of *dysmenorrhœa* are also greatly alleviated by it. The evidence is conclusive that this remedy also suspends *after-pains*, and it is held by some good observers that it quiets the "nagging" pains of the first stage of labor. In these disorders of the female sexual organs, it is generally necessary to administer a quantity of the remedy sufficient to produce some of its characteristic physiological effects. According to Bulkley, it is an effective remedy for the relief of *pruritus*, and has given excellent results in the treatment of *eczema.* He prescribes from three to ten drops of the tincture, giving it every two or three hours until some of its characteristic effects appear.

The first empirical use of gelsemium was in the treatment of the *remittent* or so-called *bilious fevers* of the South. A considerable number of facts have been accumulated, which show that this remedy exercises a really beneficial influence in *remittent* and *typo-malarial fevers.* It is not an action of specificity—like quinine in *intermittent* and *remittent fevers*—and it is doubtful whether this supposed beneficial effect has any proper basis.

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Arnicæ Flores.—Arnica-flowers. The flower-heads of *Arnica montana* Linné (Nat. Ord. *Compositæ.*)

Arnicæ Radix.—Arnica-root. The rhizoma and roots of *Arnica montana*. *Racine d'arnica*, Fr.; *Arnicawurzel*, Ger.

Extractum Arnicæ Radicis.—Extract of arnica-root. Dose, gr. j—gr. iij.

Extractum Arnicæ Radicis Fluidum.—Fluid extract of arnica-root. Dose, ♏ v—♏ x.

Tinctura Arnicæ Radicis.—Tincture of arnica-root. Dose, ♏ x—♏ xxx.

Tinctura Arnicæ Florum.—Tincture of arnica-flowers. Dose, ♏ x—ʒ ss.

COMPOSITION.—The chemistry of arnica has not as yet been thoroughly elucidated. Walz has isolated a principle (***arnicine***). The root contains an *essential oil* on which depends, in great part, its physiological activity. The oil is a complex substance. One of its most important constituents is *trimethylamine*, or an analogous principle.

ANTAGONISTS AND INCOMPATIBLES.—The actions of arnica are antagonized by ammonia, alcoholic stimulants, opium, camphor, etc.

SYNERGISTS.—Aconite, veratrum viride, digitalis, and arterial sedatives generally, increase the effects of arnica.

PHYSIOLOGICAL ACTIONS.—Arnica excites considerable irritation of the skin, if the contact be sufficiently prolonged. It produces when swallowed a sense of heat and acridity in the fauces, and increases the flow of saliva. It is decidedly irritant to the stomach, and causes in large doses nausea and vomiting, and choleraic diarrhœa. Its active principles diffuse into the blood. In small medicinal doses arnica increases the action of the heart and arteries, and excites the functions of the skin and kidneys. In large doses, probably after a short stage of excitement, depression of the circulation, of the respiration, and of the animal temperature, ensues; violent headache is experienced, the pupils are dilated, and paresis of the muscular system comes on. In toxic doses arnica paralyzes the nervous system of animal and organic life, and death ensues in a condition of collapse.

THERAPY.—In *febrile diseases* and *inflammations*, when there is sthenic reaction, arnica in full doses depresses the action of the heart and lowers the arterial tension. It is, therefore, *antipyretic*. For the production of this effect, an infusion is probably a better preparation than the tincture. When, however, in febrile diseases there is present the condition of asthenia, small doses of the tincture (five minims) are to be preferred. That this remedy will produce different results, in small or large doses, need not occasion surprise. It is conceded on all sides that the effects of opium differ according to the size of the dose, and the frequency with which it is repeated.

Good results have been obtained from the use of arnica infusion in *mania* and *melancholia*. The tincture of arnica is exceptionally serviceable in *delirium tremens*, with depression.

In *rheumatism* and *rheumatic gout*, very decided curative effects are sometimes procured from arnica. The fact that it contains *trimethylamine* is probably the true explanation of its utility in these affections. It has also proved very efficacious in *acute eczema*, in *erysipelas*, and other cutaneous affections of gouty and rheumatic origin. *Dysmenorrhœa* of the congestive form, *acute metritis*, and other acute pelvic inflammations, are also favorably influenced by the administration of arnica.

The tincture of arnica has a popular reputation for the relief of *sprains*, *bruises*, and external inflammations. The author has known violent erysipelatous inflammation to follow its application to a sprained ankle. It is extremely doubtful whether the good effects are more decided than those of a spirit-lotion. The infusion or decoction does not, it is said, cause local irritation. Planat has demonstrated that arnica is a remarkably effective application to *boils*. He directs one part of the extract and two parts of honey to be thoroughly incorporated, and the paste spread on some adhesive plaster, leaving a margin to secure its adhesion to the skin. The plaster is renewed every twenty-four hours. To increase the effect, Planat gives by the stomach the tincture of arnica.

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Trimethylamine.—(Unofficial.) This is an ammoniacal substance, having a strong, fishy odor. It is isomeric with *propylamine*, which is also an ammonia. As the propylamine of commerce is a mixture of various substances, and is of uncertain composition, trimethylamine only should be used (Spencer). The dose of trimethylamine is four to eight minims. Its disagreeable taste may be disguised somewhat by peppermint-water.

Properties.—Trimethylamine is a colorless liquid, having the composition C_3H_9N. It dissolves freely in ether, alcohol, and water, has a strong alkaline reaction, and is inflammable.

Chloride of Trimethylamine is a stable salt which crystallizes in long needles ; it is very deliquescent, and its solution when concentrated has a caustic action on the skin and mucous membrane. It is free from odor, except when heated or mixed with an alkali, when the fishy smell is evolved. The taste of a solution of this salt is alkaline, but not disagreeable (Dujardin-Beaumetz). Dose, grs. ij to grs. v every three hours.

Antagonists and Incompatibles.—Chemically trimethylamine is incompatible with the mineral acids, the salts of the metals, the alkalies (chlorides), and vegetable infusions. It should always be prescribed alone, in solution in some aromatic water. Therapeutically, it is antagonized by the stimulants, opium, belladonna, digitalis, etc.

Synergists.—All agents depressing the vascular system and the temperature are synergistic.

Physiological Actions.—Applied to the skin, mucous membrane, or areolar tissue, trimethylamine produces decided caustic effects, comparable to those which result from the action of ammonia. It excites gastric pain when taken into the stomach in considerable doses, and will, doubtless, cause a high degree of inflammation if incautiously administered. The most characteristic effects are the lowering of the action of the heart, the depression of the temperature, and the diminution in the amount of urea excreted. In the physiological state Dujardin-Beaumetz found, in some experiments on himself, that the chloride of trimethylamine lessened the temperature and the pulse, but these results were much more decided when it was administered in cases of acute rheumatism. The influence which this agent has on the excretion of urea is still more remarkable. The observations of Dujardin-Beaumetz show that a gradual but considerable decline in the excretion of urea is a constant result of its administration. On the other hand, Spencer says that the excretion of urea is sometimes increased, and, in one case in which the urinary discharge was carefully studied, the urine was almost trebled, and the urea more than doubled by the use of this remedy. If the diminution of the amount of urea were a constant result, as claimed by Dujardin-Beaumetz, the influence which trimethylamine has on the body temperature might be due to an interference with the combustion process. But the facts do not as yet justify the construction of a theory as to its mode of action.

Therapy.—Thus far almost the only application made of trimethylamine is in the treatment of *acute rheumatism* and *gout*. In some cases it appears to produce almost complete relief after the administration of a few doses, but generally a longer time is required (Awenarius, Dujardin-Beaumetz, Spencer, Leo). It moderates, at once, the fever and the joint-pain, and very decidedly shortens the duration of the disease. It is said to diminish the tendency to cardiac complication.

This agent, having so decided an influence on the pulse, temperature, and excretion of urea, will in the future doubtless be applied to the treatment of other maladies.

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Spencer, Dr. W. H. *On the Employment of Trimethylamine in Rheumatism and Gout. The Practitioner*, February and March, 1875.

Pilocarpus.—Jaborandi. The leaflets of *Pilocarpus Selloanus* Engler (Nat. Ord. *Rutaceæ, Xanthoxyleæ*).

Infusum Pilocarpi.—Infusion of pilocarpus (℥ ij—Oj). Dose, ℥ ss—℥ ij. (Not official.)

Extractum Pilocarpi Fluidum.—Fluid extract of pilocarpus. Dose, ʒ ss—ʒ ij.

Tinctura Pilocarpi.—Tincture of pilocarpus (℥ iv—Oj). Dose, ʒ ss—ʒ ij. (Not official.)

Composition.—The important constituent is the alkaloid—*pilocarpine*—which possesses the physiological properties of the drug. It combines with acids to form salts. The salts of pilocarpine crystallize in the oblique system. In 1880 another alkaloid was discovered, and to this the name *jaborine* was given (Harnack und Meyer). Subsequent researches fully confirmed this (P. Castaing). These alkaloids are closely related in composition: probably identical, but having a different molecular arrangement. By heat, merely by concentration of an acid solution, pilocarpine is converted into jaborine (Hans Meyer); and by washing with absolute alcohol they are separated, when united, as is very often the case in the commercial article. As these two alkaloids differ very greatly in properties, it is not surprising that the observations made with pilocarpine at first were very discrepant. Chemically they differ in that the salts of jaborine do not crystallize, and they dissolve more easily in ether and less easily in water. Physiologically, they differ even more decidedly. Jaborine acts like atropine, to which pilocarpine is a physiological antagonist.

Pilocarpinæ Hydrochloras.—Pilocarpine hydrochlorate. Minute, white crystals, deliquescent, odorless, having a faintly bitter taste and a neutral reaction. Very soluble in water and in alcohol, but almost insoluble in ether or chloroform. Dose, gr. $\frac{1}{12}$—gr. ss.

Antagonists and Incompatibles.—The caustic alkalies, the persalts of iron, and the salts of the metals generally, are chemically incompatible. A remarkable antagonism has been shown to exist between pilocarpine and belladonna (Ringer and Gould).

Synergists.—Aconite, veratrum viride, gelsemium, and remedies which paralyze the vaso-motor nervous system, promote the activity of jaborandi.

Physiological Actions.—The taste of jaborandi is rather hot and pungent. The considerable doses of the crude drug required to produce physiological effects excite nausea and vomiting, especially if taken on an empty stomach. It has been shown, however, in recent experiments, that these results follow the use of the alkaloid ; hence it may be concluded that not bulk alone is the cause of the gastric distress, but that it is one of the physiological properties of the drug.

The active principles of jaborandi diffuse readily into the blood. In about ten minutes after the infusion is swallowed, the face, ears, and neck become deeply flushed. Simultaneously perspiration begins on the skin, an abundant flow of saliva takes place, the nasal and bronchial mucus, and the tears, are increased, and watery diarrhœa may occur. It is said that, when the salivary secretion is greatly increased, that of the skin is relatively less so, and *vice versa* (Féréol), but this is not generally admitted. The quantity of perspiration poured out by the skin is enormous—the sweat runs from the body and soaks the clothes. The quantity of saliva discharged is also very great. Ringer reports that in two of his cases the amount of saliva was respectively twenty-two ounces and twenty-seven ounces. According to Petithau, the sialogogue effect is constant, the diaphoretic action is somewhat less certain, and the diuretic effect uncertain. These conclusions are in accord with the general experience.

The action of the heart is increased by jaborandi, but the arterial tension is notably diminished. The rise in the pulse-rate averages twenty beats, and the duration of this effect is about two and a half hours. A very distinct fall of temperature (0·5° to 2° Fahr.) ensues when the sweating begins, and this decline of body-heat is maintained on an average about four and a half hours. According to Robin, Gillet de Grandmont, and others, a transient rise of temperature precedes the fall, but Ringer and Riegel deny the accuracy of this observation. In some subjects, very serious symptoms due to the sudden development of extensive pulmonary œdema have been observed by Thomas, Napier, Sanger, Jenkins, and others.

The nauseant effects of pilocarpus and its alkaloid are, it is probable, referable to the action which it exerts on the muscular layer of the stomach and intestines. Very active movements of these organs follow its administration, and even a tetanizing action is observed. Secretion of the mucous membrane is increased, due, doubtless, to stimulation of the pancreas and the glands of the mucous membrane (Harnack und Meyer, Morat).

The effects of jaborandi on children, according to Ringer, are, singularly enough, much less, for corresponding doses, than on adults, as respects the flushing, the sweating, the salivation, and the temperature.

More or less drowsiness, both in children and adults, follows the profuse sweating, and pallor succeeds to the flushing. Chilliness is experienced with the cessation of the sweating stage. Languor and debility persist for some hours after the completion of the effects. The drowsiness is probably not due to a direct action of the remedy on the cerebrum, but to the greatly-diminished vascular tonus, and to the loss of fluid from the vessels. Vision is generally affected. The pupil is usually contracted, and the power of accommodation is impaired. No characteristic or constant changes in the fundus of the eye have been observed on ophthalmoscopic examination. Locally applied to the eye, jaborandi causes "contraction of the pupil, tension of the accommodative apparatus of the eye, with approximation to the nearest and farthest points of vision, and amblyopic impairment of vision from diminished sensibility of the retina." The eye resumes its normal state in about an hour and a half (Tweedy).

The results of experiment indicate that the action of jaborandi is paralyzant of the vaso-motor nervous system. The flushing of the skin is doubtless due to dilatation of the arterioles, and the increased action of the heart must be referred to the same cause. The sphygmograph demonstrates the lowering of the vascular tension. The decline in temperature must be referred chiefly to the profuse transpiration, but the depression of the vascular tonus may also somewhat influence this result. The data do not yet exist for a statement of the mode in which jaborandi excites the salivary and cutaneous secretions. It probably affects the end-organs of the excito-secretory nerves (Harnack und Meyer, Vulpian, Dujardin-Beaumetz, Grocco, and others).

That pilocarpus stimulates the gravid uterus is affirmed by many observers. Vander Neg asserts that, when injected subcutaneously or into a vein, it promptly induces uterine contractions, or increases the energy of those already existing. Kleinwachter reports two cases in which it induced premature labor. Three injections of two centigrammes each produced this result in one case, and two injections sufficed in the other. Dr. Prochownick, of Hamburg, also reports two cases of eclampsia, in which the hypodermatic injection of hydrochlorate of pilocarpine inaugurated labor in a half-hour. It frequently fails, even in considerable doses, to have this effect. Of nine reported instances in which it was used to induce premature labor, in six it was successful and in three it had no effect. The cases in which uterine action has been induced were chiefly eclampsia, and hence there is an important source of fallacy.

Elimination of the active constituents of jaborandi probably takes place through the organs whose functions are so powerfully excited. It is a remarkable circumstance that the amount of urea passing out in the sweat caused by jaborandi is enormously increased over the normal, amounting to from fifteen to seventeen grains. The urine is not increased, as a rule, but Gubler apparently demonstrated that small doses frequently repeated had a distinct diuretic action. His theory is based on the notion that, being a universal gland-stimulant, if the skin is not directly stimulated and the fluids directed to it, the kidneys will be acted on. In some instances the growth of hair has been promoted by the subcutaneous and topical application of pilocarpus (Prentiss, André, and others).

The experiments which have demonstrated the existence of a physiological antagonism between jaborandi and belladonna have thrown much light on the action of the former. When the heart of a frog is arrested in the diastole by jaborandi, it immediately recommences its beat when atropine is subcutaneously injected (Langley). When the superior ganglion of the cervical sympathetic, and the lingual, and the pneumogastric nerve are divided, jaborandi administered causes profuse salivary secretion; but this action is at once antagonized and the secretion arrested by the injection of atropine. These agents, therefore, are exactly opposed as respects their action on the nerve-endings in the salivary glands (Carville). The effects of one grain of atropine, in a boy poisoned by it, were, as respects the state of the mouth and skin, antagonized by thirty grains of jaborandi. In three men the perspiration and salivation caused by sixty grains of jaborandi were arrested by the subcutaneous injection of $\frac{1}{100}$ of a grain of atropine (Ringer and Gould).

Comparative Action of Pilocarpine and Jaborine.—The differences in physiological action between these alkaloids are infinitely greater than the chemical. There does not exist a finer illustration of the importance of molecular arrangement to physiological action. Given two alkaloids having the same ultimate constituents, their actions become antagonistic by reason of an unknown molecular arrangement. Jaborine, in its effects on the heart, lungs, pupils, and salivary glands, is identical with atropine. In the whole range of physiological antagonisms, there is none more complete than that existing between atropine and pilocarpine. As in some specimens of pilocarpine—owing, doubtless, to faulty pharmaceutical processes—there is more or less jaborine, it is no longer difficult to explain how some observers have differed in their observations. As the effect of pilocarpine on the circulation and the sweat-glands is so completely antagonized by jaborine, it is in a high degree important, in prescribing the former, to secure a specimen free from the latter.

THERAPY.—Pilocarpus, acting as it does on the salivary glands, has been used with varying success in *mumps*, sometimes succeeding well, and then failing. According to Testa, if used in time it may arrest the development of the disease, and later may prevent metastasis.

In *salivation of pregnancy*, it has succeeded in a few instances, but more frequently fails; atropine is generally much more certain and effective. It is contraindicated in all affections of the gastro-intestinal mucous membrane, and in weak heart due to disease of its muscular substance, or of its contained ganglia, or of the valves. It is a remedy of great value in *cardiac dropsy*, provided the contraindications above mentioned do not exist; its therapeutic power being much the same as the vapor, hot-air bath, and other means for promoting free diaphoresis. The effusions of recent *pleuritis, hydrothorax*, and *ascites*, have been quickly removed by this agent. In *asthma* with profuse expectoration (humid asthma), and in *bronchitis* with abundant, non-purulent exudation, it has often been very beneficial. It must be used with caution, or not at all, in the difficult breathing due to dilatation of the right cavities and great venous trunks. According to Berkhart, pilocarpine, injected subcutaneously, arrests the most violent paroxysms of *spasmodic asthma*, and the relief persists for some time. It is equally effective, in the author's experience, in *singultus* or hiccough, but there may be incurable lesions underlying the spasm, when, of course, the paroxysms may be expected to recur again.

Probably the most conspicuous good results from the administration of pilocarpine have been obtained in *eclampsia*, from the albuminuria of pregnancy, of scarlatina, or of acute Bright's disease. The powerful action on the sudoriparous glands, and the excretion of the urinary solids by the sweat, are the causes of the extraordinary relief obtained from this remedy in suitable cases. It should be borne in mind that pilocarpus tends to excite uterine action, and hence its administration may, under some circumstances, be improper; but in most cases this effect is desired. There are, however, two important contraindications: a weak heart, from thinning and atrophy of the walls of the organ, or from fatty degeneration, and a tendency to pulmonary congestion and œdema. In some instances, in a few minutes after the injection, the respiration became embarrassed by congestion and œdema of the lungs and by enormous bronchial secretion (Sanger, Napier, G. Thomas). It may be well to mention that atropine, subcutaneously, in one case in which it was administered, removed these symptoms and saved the patient's life. In *renal dropsy*, especially scarlatinal, there being no contraindication in the state of the heart, it is a remedy of the greatest utility.

Pilocarpine has proved to be an important addition to the resources of the ophthalmologist. In inflammatory affections with effusion and exudation it brings about resolution and absorption (Wecker). According to Coursserant, there is no remedy comparable to it in the *amblyopia of alcoholism and of tobacco-abuse*. It has produced excellent results in *detachment of the retina*, chronic *iritis, keratitis,* hæmorrhages into the vitreous, floating bodies, glaucoma, *atrophic choroiditis*, hæmorrhages and exudations of the retina, commencing atrophy of the optic nerves, etc. (Gillet de Grandmont, Meyer, Gubler, Wecker, and others). The first-named author affirms that we find in pilocarpine "an absolute remedy against white atrophy." Beranger, following Gubler, proposes to use this remedy as a substitute for eserine in certain ocular affections requiring a myositic—an effect produced by pilocarpine when instilled in the eye. It has been used successfully *de novo* and as a substitute for eserine in certain paralyses of the ocular muscles—those consecutive to the fevers and other acute diseases. After the operation for cataract extraction, pilocarpine is used by Chalot to prevent exudations and other inflammatory changes. In the discussion which ensued before the Geneva Congress where this paper was read, various adverse opinions were expressed regarding the exhibition of this remedy in different ocular maladies. Especially was the danger emphasized—the danger in cases of cardiac and arterial diseases, and of pulmonary engorgement.

Ringer has used jaborandi with success to *increase the secretion of milk*. As the milk-glands correspond in structure to the sudoriparous glands, and are merely differentiated and specialized for their particular office, the effects of this drug in increasing the production of milk might have been, *a priori*, expected. The author has used recently a fluid extract of jaborandi successfully in a case of deficiency in the secretion of the milk of a nursing-woman. But Dr. Max Strumpf denies that it has such power.

In two cases of that very intractable disorder, *diabetes insipidus*, or polydipsia, Laycock has used jaborandi with the effect to reduce the quantity of urine in one case from three hundred ounces to one hundred and twenty ounces per diem, and, in the other, from one hundred and fifty-eight ounces to ninety-eight ounces per diem. M. Huchard reports the cure of a case of the same kind, and also one of *glycosuria*; on the other hand, Vulpian declares it to be useless. Murrell has found it to be useful in some cases of the sweats of phthisis and of other nocturnal sweats, but yet far inferior to atropine and picrotoxin.

In *scaly skin eruptions*, pilocarpus has good effects by maintaining a moist state of the skin. It is the most efficient remedy for *alopecia* which we possess. In the treatment of this affection pilocarpine may be injected subcutaneously, or the fluid extract can be applied locally. The following is a very successful topical application: ℞ Ext. pilocarpi fl., ℥ j; tinct. cantharidis, ℥ ss; lin. saponis, ℥ ijss. M. Sig.: The scalp must be well rubbed with this lotion daily. In *prurigo* Pick had success, but failed in psoriasis, and he also succeeded in two cases of *pruritus senilis* and in one of *urticaria*. In *alopecia pityrodes*, he had good results in ten cases, but not in alopecia areata.

Pick administered one sixth of a grain three times a day by the stomach.

Recently Guttmann has brought forward pilocarpine as a remedy for *diphtheria*. He reports having successfully treated eighty-one cases without a single death, but these extraordinary results have not been confirmed. Numerous observations have been published, but out of the mass of cases and reports we can select only some of the most important. Soon after Guttmann's paper appeared, confirmatory statements were published by Lax, and directly contradictory by Lashkewitz. The latter lost all his cases treated with pilocarpine. Pitschen and Dilewsky, on the other hand, succeeded in curing many which would otherwise, they think, have died. Archambault treated twenty-one cases according to Guttmann's plan, and of these twelve died, a result which he considers bad. In this country Jacobi was one of the first to make a trial of the new remedy, and he pronounced against its utility. Payraudeau, who has made an exhaustive study of the subject, offers some conclusions which seem to the author eminently sound. The false membrane in inaccessible situations is softened and detached by the action of pilocarpine ; it does not effect the elimination of the diphtheritic poison by the sweat which it induces ; it is apt to cause nausea, vomiting, and diarrhœa, and may in this way greatly increase the danger of the case ; it is positively contraindicated when the cardiac muscle is weakened in any way. Although these positions are perfectly tenable, there are facts more favorable to the utility of pilocarpine. They are well stated by Courtois : The results of the treatment of diphtheria by pilocarpine, without being so good as were at first supposed, are nevertheless worthy of careful consideration. Children of less than five years offer such slight resistance to the action of the morbific germs of diphtheria, that they are rarely cured. Those above this age, in which the mixed form of the disease is most frequent, are especially favorable subjects for this treatment. The false membrane is more thoroughly detached, and has less tendency to be reproduced, than by any other treatment. An experienced German physician of Philadelphia, Dr. Löling, assures me that he finds it highly useful when the condition of the heart does not contra-indicate. Having observed cases in the course of the treatment, I am able to confirm Dr. Löling's statements. All are now agreed that efficient support must be given the patient by food and alcohol during the pilocarpine treatment ; that cases characterized by extreme depression of the vital powers, and by weakness of the heart, are unsuited for this remedy.

Guttmann exhibited pilocarpine with hydrochloric acid and pepsin by the stomach, giving from $\frac{1}{16}$ gr. to $\frac{1}{6}$ gr.

This subject must not be closed without some observations on the remarkable aid afforded by pilocarpus in the removal of exudations, under treatment by the remedies most effective for this purpose—iodides and mercurials. Above, attention has been called to the use of pilocarpus in causing absorption of effusions in the pleural, peritoneal, and other serous cavities; but in this application it is used conjointly with iodine and mercury, chiefly to increase the rate at which the exudates liquefied by these sorbifacients are taken up and excreted. In cases of *gummata*, for example, the specific action of mercury or iodine is rendered effective by the timely and conjoint use of pilocarpus, exhibited once or twice a day. When the inflammatory deposits in chronic pneumonia, or chronic pleuritis, or in other organs are sought to be removed, the persistent administration of mercury and iodine will accomplish far more if, during their administration, pilocarpine is given after certain periods have elapsed—for example, after one week, and for three or four days in each succeeding week. The size of the dose, and the amount given each day, will be determined by the degree of the action. The author has found that a dose large enough to cause but little sweating and salivation suffices.

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Physostigma.—Calabar bean. The seed of *Physostigma venenosum* Balfour (Nat. Ord. *Leguminosæ, Papilionaceæ*). *Fève de Calabar*, Fr.; *Kalabarbohne*, Ger.

Extractum Physostigmatis.—Extract of physostigma. Dose, gr. ⅛—gr. ss—gr. j.

Tinctura Physostigmatis.—Tincture of physostigma. Dose, ♏ v—♏ xx.

Composition.—Calabar bean contains two alkaloids, *physostigmine* or *eserine* and *calabarine*. These have been supposed to be the same, but they differ in physiological action; physostigmine paralyzes, whereas calabarine has a tetanizing action. "Eserine" has been more used than "physostigmine" to designate the alkaloid.

Physostigminæ Sulphas.—Physostigmine sulphate. A white or yellowish-white microcrystalline powder. Very soluble in water and in alcohol. Dose, gr. $\frac{1}{100}$ to gr. $\frac{1}{60}$.

Physostigminæ Salicylas.—Physostigmine salicylate. In colorless, shining, acicular, or short columnar crystals, turning reddish on long exposure to light and air, odorless, having a bitter taste and a neutral reaction. Soluble in 130 parts of water, and in 12 parts of alcohol at 59° Fahr. Dose, gr. $\frac{1}{100}$—gr. $\frac{1}{60}$.

Antagonists and Incompatibles.—The vegetable astringents, tannic acid, and the caustic alkalies, are chemically incompatible. As respects physiological actions, physostigma is antagonized in a limited part, but not in the whole of its actions, by atropine, and still more by chloral. Therapeutically, the tetanizing agents may be regarded as opposed to physostigma.

Synergists.—The paralyzers, or depressors of the motor nervous system, conium, gelsemium, nitrate of amyl, etc., act in harmony with physostigma, increasing its effects in the whole range of its physiological influence.

Physiological Actions.—The preparations of physostigma are apt to excite nausea. Increased secretion of the gastro-intestinal mucous membrane, and increased peristalsis, follow their administration. The active principles quickly diffuse into the blood. Physostigma does not impair the respiratory function of the blood, but, after death, loose coagula are found, the globules have undergone changes of shape, and rectangular plates of hæmato-crystallin occur (Leven and Laborde). The action of the heart is affected by considerable toxic doses; it is paralyzed in the diastole, and is flabby, but it contracts lazily on electric stimulation. In less than lethal doses the action of the heart is slowed, and the arterial tension is, for a brief period, lowered, but soon rises considerably above the normal. As these effects are not due to an action on the inhibitory apparatus, and follow when the heart is separated from the vaso-motor center by division of the spinal cord, it is probable that the action consists in a stimulation of the cardiac ganglia, and a subsequent paralyzing action on the cardiac muscles. The same result may be due to a paralyzing action on the accelerator nerves of the heart (Köhler). The respiration is more powerfully affected than the circulation. When a lethal dose is administered the respiration becomes slower and shallower, and death ensues from arrest of the respiratory movements (asphyxia), the heart continuing in action for some time afterward.

Physostigma does not affect the centers of conscious impressions, and consciousness is preserved until the oxygenation of the blood is so far interfered with that carbonic-acid narcosis supervenes. Giddiness, vertigo, and a sense of muscular weakness and fatigue, are produced by considerable doses (Gubler). When a lethal dose is administered to an animal, its muscular system soon grows weak, and complete paralysis soon after ensues. The voluntary muscular system, however, before complete resolution occurs, is agitated by a succession of tremors—temporary tetanic contractions followed by entire relaxation. These muscular tremblings occur, but more feebly, after complete paralysis, and persist in a slight degree after death. The muscular contractility is not destroyed, not even impaired, by physostigma.

The irritability of the motor nerves is affected, if at all, to a very slight extent, and the sensibility of the sensory nerves is rather heightened. It follows from these facts that the paralyzing effect of physostigma is due to a direct action on the spinal cord.

As respects its effects on the eye, we find that it is eminently characteristic, and whether introduced directly into the eye, or taken into the stomach, or thrown under the skin, it contracts the pupil. This is a local and peripheral action, exactly corresponding, as to its seat, to the action of atropine. The end-organs of the sympathetic, or of the motor oculi, and it may be of both, are acted upon. By some it is held that the contraction of the pupil is due to a tetanic state of the circular fibers (Grünhagen, Rogow); by others, to a paralysis of the dilator system (Fraser, Hirschmann). It were probably safer to accept the conclusion that the nerves innervating both sets of fibers are acted on—the motor oculi stimulated (see case by T. Wharton Jones, "Practitioner," vol. iii), the sympathetic depressed—for we find that tetanic contraction of the muscular fiber of the intestine, followed by dilatation and a paretic state, can be experimentally produced by physostigma. The apparatus of accommodation is also affected; myosis begins in ten to fifteen minutes after eserine is inserted. Direct galvanization of the iris, contracted by physostigma, causes it to dilate (Engelhardt, Hermann).

THERAPY.—The applications of physostigma to the treatment of disease are by no means so important as the elaborate study given to its physiological action, by various observers, would seem to indicate.

In *torpor of the muscular layer of the intestine, combined with deficient secretion of the mucous membrane*, this agent is often very serviceable. In some subjects fifteen minims of the tincture or a half-grain of the extract, taken at bedtime, will procure a morning evacuation, but it frequently fails. When the state to be relieved is such as is indicated above, a combination of physostigma, belladonna, and nux-vomica, is sometimes very effective: ℞ Tinct. physostigmatis, tinct. nucis vomicæ, tinct. belladonnæ, āā ʒ ij. M. Sig. *Thirty drops in water, morning and evening.* ℞ Extract. physostigmatis, ext. belladonnæ, ext. nucis vomicæ. āā gr. v. M. Ft. pil. no. x. Sig.: *One pill at bed-hour.* Physostigma (gr. ¼—gr. ss of the extract) is a useful addition to a cathartic pill. ℞ Ext. physostigmatis, resinæ podophylli, āā grs. iij. M. Ft. pil. no. vj. Sig.: *One pill at bed-hour.*

To the troublesome *flatulence of women at the climacteric period*, usually associated with a paretic state of the muscular layer of the bowel, very great relief is often afforded by the use of physostigma. With the relief to the flatulence there usually follows relief to the morbid fancies, the headache and vertigo connected with it.

The action of physostigma on the spinal cord, as a paralyzer, naturally suggested its use in *tetanus*. The evidence of its utility is discrepant. Moreover, tetanus, in many instances, manifests a tendency to spontaneous cure. It is difficult, therefore, to estimate the precise value of physostigma, but about one half of the cases treated with this agent recover—according to Watson, ten in eighteen; according to Roemer, twenty in forty-seven cases. A larger measure of success might have been achieved, had sufficient attention been paid to the quality of the extract used and to the mode of administration. The following remarks by Dr. Fraser, in regard to the treatment of tetanus by Calabar bean, are of great importance:

"I should myself feel inclined always to commence the treatment by subcutaneous injection, and to repeat such injection until the system is decidedly affected, and then to administer the remedy by the mouth in a dose three times as large as is found necessary by subcutaneous injection. Such a plan might be quite safely followed in a child of even nine years. If the remedial effects continue to be produced by administration by the mouth, it should be persevered with, for such administration has obvious advantages as far as the convenience of the practitioner is concerned. In the more severe cases, however, I believe subcutaneous injection should be alone employed. The distress and increase of spasm caused by swallowing, or the impossibility of introducing substances by the mouth, will render this necessary. I can not, also, too strongly urge that subcutaneous injection should always be used when severe and continued spasms occur, when a fatal result is imminent from the exhaustion caused by prolonged and frequent convulsions, and when apnœa threatens at once to close the tragic scene. By it we obtain the quickest and most powerful effect.

"From the preceding remarks it can not be expected that any arbitrary rules of dosage can be laid down. For an adult one grain of the extract by the stomach, or one third of a grain by subcutaneous injection, will generally be sufficient to commence with. This should be repeated in two hours, when its effects will usually have passed off, and the succeeding doses may be modified according to the experience that will be thus gained. . . . The great object is to produce as quickly as possible, and then to maintain, the physiological effect of physostigma in diminishing reflex excitability. The doses must, therefore, be continued in increasing quantities until this physiological effect is produced, or until the sedative action of the drug on the circulation is carried to a dangerous extreme, or until constant nausea and vomiting compel us to desist."

Influenced by theoretical considerations, physostigma has been prescribed in *chorea* and *epilepsy*, but the results have not been encouraging. It is true, successful cases of *chorea* have been reported, but the influence of favorable hygienic surroundings and time is so great in uncomplicated chorea, that we may well doubt whether physostigma has any real influence. Of twelve cases of epilepsy treated by this agent, six were improved, and in the other six a notable increase in the number of the epileptic paroxysms took place (Williams).

In *progressive paralysis of the insane*, remarkable improvement has occurred under the use of physostigma in a few cases (Browne), but in others the results have been entirely negative (Williams). As in this melancholy disorder no remedies have hitherto been of any avail, it is a gratifying fact that in some cases Calabar bean has seemed to stay its progress.

Since it has been shown that physostigma lessens the activity of the respiratory function, lowers the action of the heart, and depresses the temperature, it has been used in *bronchitis, congestion of the lungs*, and *pneumonia*, with a degree of success which warrants more extended and systematic use.

Besides the various applications in ophthalmic practice growing out of the myosis produced by physostigma, it has been used with success in certain *paralytic and convulsive states of the ocular muscles*. In a case of *paralysis of the third nerve*, with ptosis, double vision, and immobile pupil, Wharton Jones effected a cure by the instillation of physostigma into the eye, whence he concludes that the myosis caused by this agent is due to the stimulation of the third nerve. Galezowski recommends the instillation of physostigma into the eye in cases of *suppuration of the cornea* and in *amblyopia*. Eserine disks (of gelatin) have been successfully employed in *tic*.

The experiments—thirty in number—of the British Medical Association Committee, with regard to the antagonism between physostigma and strychnine, have led them to the following conclusion:

"Although the symptoms produced by either substance were modified considerably by the action of the other, there was no instance of recovery from a fatal dose."

The antagonism between atropine and physostigma, at least to a considerable extent, has been well established, especially by the labors of Fraser. In 1864 Kleinwächter, influenced probably by the marked antagonism of the two agents on the pupil, employed physostigma with success in a case of poisoning by atropine. The British Association Committee, however, conclude as the result of their investigations that—"1. Sulphate of atropine antagonizes to a slight extent the fatal action of extract of Calabar bean ; 2. The area of antagonism is more limited than even Dr. Fraser has indicated in his paper on the subject.

"Thirty-one experiments, performed by the committee with hydrate of chloral and Calabar bean, have shown that—

"1. Hydrate of chloral modifies to a great extent the action of a fatal dose of extract of Calabar bean, mitigating symptoms and prolonging life.

"2. Hydrate of chloral, in some cases, saves life from a fatal dose of Calabar bean.

"3. If hydrate of chloral be given before extract of Calabar bean, so that the animal is deeply under the influence of hydrate of chloral before it receives the extract of Calabar bean, the symptoms produced by the latter are much modified, and life is saved from the effects of what would otherwise be a fatal dose.

"4. Chloral hydrate is of little service as an antagonist to extract of Calabar bean, if given some time after the latter. If the symptoms of the action of Calabar bean be in full operation, it will not save life, however it may modify symptoms."

Uses of Eserine.—This alkaloid represents the powers of the plant, and is the most eligible form for internal administration, and for local use in ophthalmic therapeutics. Merck, however, maintains that the salicylate of physostigmine is the best preparation of the alkaloids, and it has been made official. The dose for internal and hypodermatic use ranges from $\frac{1}{60}$ to $\frac{1}{12}$ of a grain. Gelatin disks of eserine are now most frequently employed for instillation into the eye, but a neutral solution of any of its salts is convenient for this purpose. It is now largely used to counteract the *effects of atropine* on the pupil ; in *iritis*, to break away or prevent the formation of adhesions ; in *ulceration* and suppuration of the cornea ; after *extraction* of *cataract*, to prevent suppuration (Wecker) ; in the operation of *iridectomy*. The curative influence of eserine in these cases is due to its action in lowering the intra-ocular tension, in diminishing the conjunctival secretions by contracting the blood-vessels, and in checking the migration of the white blood-corpuscles (Wecker). Eserine may be substituted for physostigma for all purposes, by the stomach or hypodermatically.

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Tabacum.—Tobacco. *Tabac*, Fr. ; *Tabakblätter*, Ger. The commercial dried leaves of *Nicotiana tabacum* Linné (Nat. Ord. *Solanaceæ*).

Infusum Tabaci.—Infusion of tobacco (ʒj—Oj). Dose, as an enema, ℥ss—℥iv. (Not official.)

Oleum Tabaci.—Oil of tobacco. (Not official.)

Unguentum Tabaci.—Tobacco-ointment (℥ss—℥viij). (Not official.)

Vinum Tabaci.—Wine of tobacco (℥j—Oj). Dose, ♏v—ʒss. (Not official.)

COMPOSITION.—Tobacco contains a powerful alkaloid—*nicotine*—in combination with malic acid. It is an oily, colorless liquid, strongly alkaline in reaction. Its taste is hot and acrid, and its odor disagreeable and peculiar. It is contained in the dried leaves, in the proportion of about five per cent.

Tobacco also contains a peculiar camphor—*nicotianine*.

Tobacco-leaves are rich in mineral constituents—potash, lime, nitrates, and phosphates. The vapor of tobacco "contains numerous basic substances of the picolinic series, and cedes to caustic potash, hydrocyanic acid, sulphureted hydrogen, several volatile fatty acids, phenol, and creosote" (Flückiger and Hanbury, Husemann). It does not contain nicotine. The oil of tobacco is an empyreumatic product, obtained by distillation.

ANTAGONISTS AND INCOMPATIBLES.—The caustic alkalies, tannin, and the iodides, are chemically incompatible. Strychnine is, according to Haughton, a true physiological antagonist. Ergot, digitalis, belladonna, ammonia, and alcoholic stimulants, antagonize the effects of tobacco on the heart and arterial system.

In cases of poisoning, the stomach should be evacuated by emetics or the stomach-pump, and tannin and the iodides should be administered. Ammonia and brandy are indicated to relieve the failing circulation. Subcutaneous injection of strychnine should also be resorted to, and, if necessary, artificial respiration.

SYNERGISTS.—All of the motor depressants increase the effects of tobacco.

PHYSIOLOGICAL EFFECTS.—Tobacco is a severe and very depressing nauseant and emetic. It is locally an irritant to the mucous membrane, and produces burning pain at the epigastrium. It is also laxative even when smoked, and in considerable quantity by the stomach causes hypercatharsis. The emetic effect of tobacco is, doubtless, the product of three factors: its cerebral action, its local irritation of the gastric mucous membrane, and its specific emetic property. The secretions of the intestinal mucous membrane are increased, and the muscular layer is thrown into tetanic contraction, whence the catharsis which follows its administration. Applied to a wounded surface, tobacco produces the same effects.

Its active principle, nicotine—the salts of which are crystalline—diffuses into the blood with great rapidity. It corresponds, in the mode and intensity of its action, to prussic acid. In a case narrated by Taylor, a fatal result ensued in three minutes after a toxic dose. In another case death occurred in five minutes (M. Fougnies, poisoned by Count Bocarmé). When a lethal dose is administered to an animal, the action of the heart continues after respiration has ceased. Its cavities are usually found empty, or containing black fluid blood. Tobacco is not, therefore, a cardiac poison, and the depression of the circulation noted when full medicinal doses are administered is, doubtless, due to the interference with the pulmonary functions. Applied directly to the muscular tissue of the heart, nicotine does not impair its contractile power (Benham). The blood throughout the body is black and fluid; but, as agitation with oxygen restores its color, and as the blood-globules are unaffected, the condition of the blood is doubtless due to the arrest of oxygenation (asphyxia).

Trembling and clonic spasms are produced by lethal doses of tobacco. Its ultimate effect is paralyzing, but preceding the muscular relaxation and paresis there is in animals, and occasionally in man, a definite tetanic stage. Death ensues through its paralyzing action on the muscles of respiration. The end-organs of the motor nerves lose their excitability, next the trunks of the nerves, and then the spinal cord, but the muscular irritability is unaffected. The brain is not directly affected. Giddiness and delirium have been noted in cases of poisoning by tobacco, but these symptoms, as well as the insensibility which immediately precedes death, are no doubt due to the accumulation of carbonic acid in the blood. The pupils are contracted by tobacco, and, in fatal cases, are insensible to light.

There is considerable sweating, and the skin is cold and clammy in fatal cases. The temperature of the body is decidedly reduced (Tscheschichin). The elimination of nicotine probably takes place by the kidneys. Very free urinary discharge, at all events, is produced by tobacco, and, reasoning by analogy, it may be supposed that this effect is due to the direct action of the nicotine on the Malpighian tufts and on the tubules of the kidneys.

When a lethal dose of nicotine has been taken, and the effects follow immediately, there may be none of the symptoms described above. In the case narrated by Taylor, the "deceased stared wildly; there were no convulsions, and he died quietly [in three minutes], heaving a deep sigh in expiring."

THERAPY.—In *habitual constipation*, due to a relaxed state of the muscular layer of the bowel, five minims of the wine of tobacco, administered at bedtime, will not unfrequently afford relief.

Impaction of the cœcum, colica pictonum, sometimes *intussusception*, and *strangulated hernia*, may be overcome by a tobacco-enema. It must be borne in mind, however, that this is an expedient not free from danger. Numerous deaths have been caused by it, and Dr. Copeland reports one instance in which thirty grains by enema proved fatal. Of the official infusion (℥ j—Oj) it is not safe to use more than four ounces, or fifteen grains; and this quantity may be expected to produce most depressing nausea. It must be urged in favor of this remedy that it has, in very unfavorable cases, proved exceedingly effective. It is especially adapted to cases in which obstruction has occurred from paresis of the muscular layer of the bowel (impacted cæcum, typhlitis, painter's colic).

Tobacco is one of the antispasmodic remedies used in the treatment of *spasmodic asthma*, and the paroxysms of difficult breathing in *emphysema*. It enters as a constituent in various pastilles and cigarettes employed in these maladies. *Asthmatics*, unaccustomed to the use of tobacco, are sometimes relieved by smoking a cigar or pipe, but the effect is lost by habitual use. *Laryngismus stridulus* may be quickly arrested by a snuff-plaster to the neck—an effective but dangerous domestic remedy. Obstinate *hiccough*, or *singultus*, may be cured by five-minim doses of wine of tobacco, but we possess other useful remedies, less dangerous and less unpleasant in action.

We possess no remedy more effective in the treatment of *tetanus* than tobacco. It may be used in the form of an enema, commencing with four ounces of the infusion, and regulating the quantity to be administered and the time of administration by the effect produced. Minim-doses of the alkaloid may be given every two hours by the stomach, or two minims by the rectum (Haughton). When it acts favorably, it relaxes the trismus so that nutriment may be taken, and suspends the tonic convulsions. Care must be used not to introduce a lethal quantity, and produce death by asphyxia. The author has known the wine of tobacco to be used successfully in a severe case of tetanus, the quantity administered being regulated by the effect of the remedy on the convulsions.

The experiments of Haughton having demonstrated an antagonism between nicotine and strychnine, he proposed the use of nicotine in *strychnine-poisoning*, and cases have occurred in which it proved entirely successful. As the effects of nicotine are so nearly instantaneous, the stomach administration—if the spasms do not prevent—will suffice, but rectal and even hypodermatic injections may be resorted to if necessary. The following formula of Erlenmeyer may be used for the subcutaneous injection in strychnine-poisoning and in tetanus: ℞ Nicotinæ, gr. ss; aquæ destil., ʒ ij. M. Sig.: *Ten minims contain* $\frac{1}{24}$ *of a grain.* The cases of strychnine-poisoning in which tobacco was used successfully were treated by the infusion.

Tobacco was formerly employed in the treatment of *dropsy*. It is adapted to those cases in which digitalis is now used. It promotes free diuresis, and is at the same time laxative—effects especially serviceable in cardiac dropsy. It is, however, so disagreeable in action that few practitioners have the temerity to prescribe it, and few patients are willing to swallow it.

There is no doubt that excessive use of tobacco lessens the *venereal appetite*. Slightly nauseating doses of the wine of tobacco will check *chordee* and *priapism*. *Satyriasis* is effectively quenched in tobacco-nausea. *Nocturnal pollutions*, due to repletion and to continence, are also usually suspended by the use of this remedy; but it is, unfortunately, so horribly depressing that the remedy may be justly considered the greater evil.

Local Uses of Tobacco.—So many unfortunate accidents have resulted from the external application of tobacco, that its use in this way is rarely justifiable. The infusion and an ointment have been employed with success in *tinea*, *scabies*, *prurigo*, *pityriasis*, etc. An injection of tobacco will destroy *ascarides*, but it is unsafe. Other and more manageable remedies have entirely taken the place of tobacco in the local diseases above named.

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Lobelia.—*Lobelia.* The leaves and tops of *Lobelia inflata* (Nat. Ord. *Lobeliaceæ*), collected after a portion of the ca have become inflated. Indian tobacco. *Lobélie enflée*, Fr.; *L* *kraut*, Ger.

Acetum Lobeliæ.—Vinegar of lobelia. (Lobelia, 10 parts; d acetic acid to make 100 parts.) Dose, ♏ v—ʒ j. (Not official.)

Tinctura Lobeliæ.—Tincture of lobelia. (Lobelia, 200 grm. luted alcohol sufficient to make 1,000 c. c.) Dose, ♏ v—ʒ j.

Extractum Lobeliæ Fluidum.—Fluid extract of lobelia. ♏ j—ʒ ss.

Composition.—The effects of lobelia are due to the presence of a peculiar alkaloid—*lobeline.* This principle is oily in consist has a pungent, rather acrid taste, a tobacco-like odor, and is stro alkaline in reaction. It is slightly soluble in water, but more f soluble in alcohol and ether. It combines with acids to form cry lizable salts, which are soluble in water and in alcohol. The a principle—lobeline—is combined in the plant with *lobelic acid.*

Antagonists and Incompatibles.—The caustic alkalies de pose lobeline; hence these are incompatible. The depressing ef of lobelia on the circulation are counteracted by digitalis, bellad ergot, and other vaso-motor excitants, by alcohol, ether, amm etc.; on the nervous system of animal life, by strychnine, picrot thebaine, etc.

Synergists.—All of the motor depressants increase the effe lobelia.

Physiological Actions.—The taste of lobelia is pungent and a and it persists for a long time in the fauces. The leaves chewed e a very abundant flow of saliva, and soon cause a feeling of epig depression and nausea, with giddiness and headache. The preparations of lobelia administered by the stomach produce, in considerable doses, a degree of nausea and depression which amounts to anguish. An abundant outpouring of gastric mucus takes place, and vomiting ensues, with great straining and distress. The action of the heart is enfeebled ; headache and vertigo are experienced ; a profuse sweat breaks out on the surface of the body ; the intestinal canal is relaxed, and the discharge of urine is increased. When a lethal dose is taken, especially if vomiting do not occur, the effects are chiefly expended on the nervous system of animal life. Muscular weakness and trembling, shallow respiration, coldness of the surface, feeble circulation, insensibility, and sometimes convulsions, have occurred. Death ensues from paralysis of the muscles of respiration—the action of the heart continuing after respiration has ceased. The insensibility is doubtless produced in the same way as by tobacco, and the cerebral effects are not the result of a direct action of the poison.

According to the investigations of Ott, lobeline, in moderate doses, first "increases the blood-pressure by acting as an excitant on the peripheral vaso-motor nervous system." This primary effect is not of long duration, a fall in the blood-pressure soon occurs, the peripheral circulation is so embarrassed from weakened power of the heart, and obstructed pulmonary circulation, that oxygenation of the tissues is rapidly impaired, and a marked reduction of temperature takes place. Lobeline affects chiefly the motor nervous system, and especially the medulla oblongata and its respiratory center (nucleus of pneumogastric).

THERAPY.—Lobelia is much employed by the self-styled physio-medical practitioners as a "sanative agent." The great quantity of mucus discharged from the stomach under its emetic action is considered by them a proof of its power as an eliminating agent. As an *emetic*, lobelia is entirely too harsh and depressant to justify its use for this purpose. In *habitual constipation*, dependent on atony of the muscular layer of the bowel and deficient secretion of the mucous membrane, good results are sometimes obtained by small doses of the tincture—ten minims—administered at bedtime. *Impaction of the cæcum*, when inflammation has not occurred, may be removed, and the bowels induced to act, by small doses, frequently repeated, of the tincture of lobelia (two drops every hour). This remedy can be used when purgatives would produce serious mischief. An infusion of lobelia as an enema has succeeded in relieving *strangulated hernia*, *intussusception*, and *fecal impactions*. This use of the agent is the same as for the corresponding administration of tobacco ; it is much safer than tobacco, and can be made to produce as decided therapeutic effects.

Unquestionably the most important application of lobelia is to the treatment of the *asthmatic paroxysm*. It gives relief in a few minutes to violent attacks of spasmodic asthma, and it sometimes happens that the relief is permanent. Frequent repetition of this remedy in the same individual, however, lessens its effects, and it may finally cease to afford any relief. To be effective in asthma, a teaspoonful dose of the acetum or tincture must be administered every fifteen minutes until nausea is induced. Free expectoration and abundant gaseous eructations take place, and the breathing soon becomes easy and calm. The efficiency of lobelia is increased by the addition of iodide and bromide of ammonium. ℞ Tinct. lobeliæ, ℥ j; ammonii iodidi, ʒ ij; ammonii bromidi, ʒ iij; syrup. tolutan., ℥ ij. M. Sig.: *A teaspoonful every one, two, three, or four hours.* The hydrobromate of lobeline is the most efficient preparation for treating the respiratory neuroses, and certain cardiac affections, such as pseudo-angina pectoris.

Whooping-cough, especially after the cessation of the catarrhal stage, has been treated successfully by lobelia, but we now possess other agents more effective and less disagreeable in action. Lobelia is, however, an excellent *expectorant.* It is adapted to cases in which the cough is dry, resonant, and spasmodic. It succeeds best in those who have attacks of cough with spasmodic difficulty of breathing, and who get up a little tough mucus after long and painful paroxysms of coughing. A lobelia-emetic will cut short an attack of *spasmodic croup*, but it is too harsh and dangerous a remedy to be employed for this purpose; but it is less dangerous than is generally supposed. In consequence of the fear which invests it, the doses given are often insufficient to effect the good results it may induce; and this is true of the various catarrhal conditions of the respiratory mucous membrane especially.

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Acidum Hydrocyanicum.—*Hydrocyanic or Prussic Acid. Acide hydrocyanique*, Fr.; *Blausäure*, Ger.

Acidum Hydrocyanicum Dilutum.—Diluted hydrocyanic acid. A colorless liquid, having a peculiar odor, and wholly volatilized by heat. It imparts a faint, evanescent red color to litmus, and is not discolored by hydrosulphuric acid. With solution of nitrate of silver, added in slight excess, one hundred grains of it produce a white precipitate, which, when washed with water until the washings are tasteless, and dried at a temperature not exceeding 212°, weighs ten grains, and is wholly soluble in boiling nitric acid.

The official diluted acid contains two per cent of anhydrous acid and ninety-eight per cent of alcohol and water. Dose, ♏ j—♏ v.

ANTAGONISTS AND INCOMPATIBLES.—The metallic salts are generally, incompatible; also the red oxide of mercury and the sulphides. Freshly-precipitated oxide of iron (hydrated sesquioxide) has been proposed as a chemical antidote, but its action is too slow. In cases of poisoning, the remedies of the greatest utility are cold affusion to the spine, the inhalation of ammonia, the stomach administration, as also the intra-venous injection of this substance, and the subcutaneous injection of ether. Atropine has been proposed as a physiological antagonist by Preyer; but the rate at which atropine is diffused, as compared with the diffusion of prussic acid, obviously will render such antagonism powerless, how much soever it may be approved on theoretical grounds. The results of experiments, as the author and others have shown, are, however, opposed to the existence of this antagonism. In addition to these measures, artificial respiration should be practiced.

PHYSIOLOGICAL EFFECTS.—Applied to the unbroken skin, it is doubtful whether hydrocyanic acid is absorbed, but in contact with a wound or an abrasion, and with the mucous membrane, it diffuses into the blood with great rapidity.

The vapor has a rather fragrant odor, similar to that of bitter almonds. Inhaled, it has speedily caused death. When the effects of the vapor are short of lethal, giddiness, faintness, embarrassed breathing, a weak, small pulse, and great muscular weakness, are produced; and there may be even coma and profound insensibility, and yet recovery ensue (Taylor).

In small medicinal doses, beyond a fugitive and very slight calmative effect, no symptoms are produced by it. When the dose somewhat exceeds the medicinal standard, there may occur transient giddiness, nausea, faintness, a feeble pulse, and general muscular weakness. The effects follow very speedily. When a very large toxic dose is taken, a few seconds only intervene from the act of swallowing until its effects are manifest, and death may ensue in two minutes or be postponed to five. Under these circumstances, the following phenomena have been observed: sudden insensibility; eyes protruding and glistening; pupils dilated and unaffected by light; extremities cold, relaxed; the skin covered with a clammy sweat; breathing convulsive, slow; the pulse extremely feeble or imperceptible; evacuations involuntary (Taylor). When the effects are slower, in consequence of the ingestion of a merely lethal dose, there are occasionally tetanic convulsions, opisthotonos, trismus, etc.

Although the effects of prussic acid are exceedingly rapid, a fatal result is not instantaneous. Various acts of volition may be gone through, provided but a few seconds are required for their performance. Several instructive instances of this kind are narrated by Taylor. The effects of hydrocyanic acid are not more rapid than can be accounted for by its distribution through the blood.

Most contradictory opinions have been expressed as to the action of prussic acid on the blood: that it at first arterializes and afterward arrests decarbonization of the blood; that it destroys the ozonizing power, and does not impair the capacity of the red blood-globules to carry and to yield up oxygen; that cyanohæmoglobin is formed by the combination of the acid with hæmoglobin, and that this combination can not take place, owing to the rapidity of the action of the poison. From this chaotic state of scientific opinion the following may be evolved: the blood is dark, owing to deficient decarbonization, but this is probably due to a spasm of the pulmonary arterioles and paresis of the muscles of respiration, whence it follows that rapid asphyxia ensues. The primary action of prussic acid on the terminal filaments of the pneumogastric, as shown by Preyer, is confirmatory of this view.

Although the action of the heart ceases after respiration, prussic acid undoubtedly exerts a direct paralyzing action on the cardiac ganglia.

The cerebral effects of this poison are, probably, indirect, the result of rapid carbonic-acid poisoning, and the sudden withdrawal of oxygen from the cerebral tissues. Direct application of prussic acid to the medulla oblongata causes (in the alligator) a sudden and complete expiration, and collapse of the lung (Jones). The tetanic convulsions which have been observed in many cases of poisoning, in animals and in man, indicate a direct action of this agent on the spasm-center; but the disappearance of the excitability of the motor nerves, and of the contractility of muscles which it causes, shows that it quickly exhausts the irritability of the spinal cord. These effects on the cord, on the nerve-trunks, and on the muscles, are also, probably, in part due to the circulation through them of blood deprived of oxygen and charged with carbonic acid. The fact that instances of recovery from a condition of profound insensibility are numerous, is confirmatory of the view just expressed. Moreover, artificial respiration exerts an undeniable influence over the lethal effects of the acid in animals (Preyer), whence it may be concluded that to supply oxygen to the blood is sufficient to arrest all of the symptoms produced by the want of oxygen and by the excess of carbonic acid.

Post-mortem rigidity sets in early after death from prussic acid, and is very pronounced. The fingers are tightly closed, the toes strongly flexed, the jaws rigid, the eyes prominent and staring. The blood is dark-colored, fluid, and the venous trunks and the cerebral sinuses are gorged.

The quantity of medicinal, diluted hydrocyanic acid necessary to produce death will vary with the age, size, and bodily vigor. Habit, also, influences to a remarkable degree the susceptibility to its toxic influence. A quantity equivalent to forty minims of the diluted hydrocyanic acid (United States Pharmacopœia) has proved fatal. As the effects of a medicinal dose are expended in a half hour to one hour, the repetition of the doses hourly will not be unsafe. Hydrocyanic acid is not a cumulative poison.

Therapy.—Hydrocyanic acid is a remedy of very considerable utility in certain affections involving the functions of the pneumogastric nerve. It is often highly serviceable in various kinds of *nervous vomiting ;* for example, the *vomiting of pregnancy*, the *vomiting which accompanies some cerebral disorders*, and the *reflex vomiting of phthisis.* The good effects are quickly, if at all, produced ; hence, if no result is attained after some days' administration, no advantage can be expected from its continued administration. ℞ Acid. hydrocyan. dil., ʒ j ; aquæ laur.-cerasi, ℥ ij. M. Sig. : *A teaspoonful every two to four hours.*

Gastralgia, when it is a truly neuralgic affection of the gastric nerves, is occasionally very quickly cured by this agent. Sometimes cases, apparently in every way suitable for its use, are not improved by it. If a few doses do not effect any amelioration, it will be useless to continue it. Cases of *indigestion accompanied by pain in the nucha, and attacks of giddiness* (stomachal vertigo), are sometimes remarkably relieved by prussic acid. *Irritative dyspepsia*, manifested by these symptoms, a red-glazed tongue, pain, epigastric tenderness, and a feeling of weight and oppression, may be, not unfrequently, much benefited, and, indeed, cured ; but while the results are often brilliant, failures are also frequent. *Enteralgia*, a malady often extremely rebellious to remedies, not unfrequently yields promptly to prussic acid.

Considerable medicinal doses of this agent are very fatal to *round worms* (lumbricoides).

Hydrocyanic acid is a successful remedy in *whooping-cough*, after the subsidence of the catarrhal symptoms. It acts by allaying irritability of the pneumogastric, and is successful just in proportion to the preponderance of the nervous symptoms. The cases in which the author has witnessed the best results were cases of *cough by habit*, after the cessation of the whooping-cough proper. The *nervous cough* of mothers, which exists during the presence of whooping-cough in the household, may be allayed by this agent. ℞ Acid. hydrocyan. dil., ʒ j ; tinct. sanguinariæ, ʒ iv ; syrp. senegæ, ℥ ss ; syrp. tolutan., ℥ ij ; aquæ lauro-cerasi, ʒ vij. M. Sig. : *One or two teaspoonfuls, according to age, every three or four hours. For irritable cough.* It sometimes happens that this agent will greatly relieve the *cough of phthisis*, but only when it is chiefly nervous.

To allay *cerebral irritation and excitement*, prussic acid has been employed with benefit (McLeod). In forty cases of *mental disorder* observed by McLeod, there was "slight or temporary amelioration" in ten; a "more decided and permanent effect," the disease being still stationary or progressive, in nineteen; and in eight cases, six of *acute mania*, and two of *acute melancholia*, "the drug has been a factor, and a very main one, in rapid restoration to reason." In the treatment of these cases, McLeod used from two to five minims of Scheele's dilute acid, which contains five per cent of anhydrous acid. His method of administration consisted in giving it at first at short intervals (every quarter of an hour), and, when effects were produced, every hour or two. He also employed it subcutaneously, in five-minim doses.

EXTERNAL USES.—In various cutaneous diseases characterized by *itching*, the local application of prussic acid affords relief. The following formulæ, from Fox, represent serviceable combinations: ℞ Bichloride of mercury, gr. j; dilute hydrocyanic acid, ʒ j; emulsion of almonds, ℥ vj. M. *Use in itching, in lichen, in the syphilodermata.* ℞ Dilute hydrocyanic acid, ʒ ss to ʒ j; infusion of marsh-mallow, ℥ v to ℥ viij. M. *Use in pruritus.* ℞ Acetate of ammonia, ℥ j; dilute prussic acid, ʒ jss; infusion of tobacco, ℥ viij. M. Sig.: *To be sponged on the part twice a day in pruritus ani or p. vulvæ.* ℞ Borax, ʒ j; prussic acid, ʒ ij; rose-water, ℥ viij. M. *In the pruritus of old people.*

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Potassii Cyanidum.—*Cyanide of Potassium.* In white, opaque, amorphous pieces, having a sharp, somewhat alkaline and bitter-almond taste, and an alkaline reaction. It is deliquescent in moist air, readily soluble in water when reduced to powder, and sparingly soluble in alcohol. Dose, gr. $\frac{1}{10}$—gr. $\frac{1}{8}$.

ANTAGONISTS AND INCOMPATIBLES.—Acids decompose it and set free hydrocyanic acid. As respects its physiological properties, its antagonists are the same as those of hydrocyanic acid.

SYNERGISTS.—Same as for hydrocyanic acid.

PHYSIOLOGICAL ACTIONS.—The effects of this salt have been already mentioned in sufficient detail in the preceding article, so far as they correspond to hydrocyanic acid. It has, however, some special physical properties which separate it slightly from the powerful agent which enters into its composition.

Applied to the unbroken epidermis, the cyanide of potassium produces at first a sensation of coldness, followed by tingling and itching, and in a half-hour the skin is found to be somewhat reddened. Prolonged contact produces a phlyctenular or eczematous eruption.

Systemic effects are produced by the local and external use of the cyanide of potassium, viz., slowing of the pulse and respiration, muscular weakness, drowsiness, and coldness. Lethal effects may follow prolonged contact with the skin, even when the epidermis is unbroken. Applied to a wound or abraded surface, this salt causes a burning pain, excites a high degree of inflammation, and produces prompt lethal effects.

THERAPY.—Cyanide of potassium may be prescribed as a substitute for hydrocyanic acid in all of the maladies for which the latter is used. This salt has, however, some special applications which we owe to Trousseau. This eminent observer has shown that a solution of the cyanide applied to the seat of painful sensations gives great relief in various forms of *reflex headache*, gastric, cardiac, pulmonary, and menstrual. The headache which accompanies the pyretic state is, according to the same authority, cured or greatly alleviated by the cyanide solution, while at the same time a favorable influence is exerted over the temperature. ℞ Potassii cyanidi, gr. x—℈j; aquæ lauro-cerasi, ℥iv. M. Sig.: *A compress, moistened with the solution, to be applied to the seat of pain.* From a quarter to a half hour of contact with the skin usually suffices.

A solution of the cyanide of potassium, of the strength given above, will remove the stains of nitrate of silver, and also the dissecting-room odor, from the hands.

Cyanide of potassium, in the form of ointment or solution, is an excellent remedy for allaying irritation in various cutaneous diseases. In *pruritus* and *urticaria*, the following formula (McCall Anderson) gives relief: ℞ Potassii cyanidi, gr. vj; pulv. cocci, gr. j; ung. aq. rosæ, ℥j. M. Sig.: *Ointment.* In *eczema with pruritus*, the same authority recommends the following: ℞ Potassii cyanidi, gr. v; sulphuris, potassii bicarb., āā ʒss; pulv. cocci, gr. vj; axungiæ, ℥j. M. Sig.: *Ointment.* A solution of the cyanide of potassium is one of the most effective applications for that very troublesome disorder, *pruritus pudendi.* ℞ Potassii cyanidi, gr. xv; aquæ lauro-cerasi, ℥viij. M. Sig.: *Lotion.* This formula is also serviceable in *lichen* and *prurigo* (Hardy).

Entomologists make use of the cyanide to destroy insects without injuring their structures. One part of the cyanide, two parts of plaster of Paris, and one and a half part of water, made into a paste and poured into a wide-mouthed bottle, sets into a solid mass, which gives off the vapor of hydrocyanic acid (Squire).

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Amyl Nitris.—Amyl nitrite. *Nitrite d'amyle*, Fr. ; *Amylnitrit*, Ger.

PROPERTIES.—A yellowish or reddish-yellow liquid, rather oily in consistence, very volatile, and having a peculiar and very diffusive ethereal odor. It is insoluble in water, but soluble in all proportions in alcohol, ether, chloroform, benzol and benzin. It has a neutral or a slightly acid reaction. It may contain, as impurities, nitric acid, amyl-nitric ether, amylvalerianic ether, and hydrocyanic acid. The specific gravity is ·877. Dose, ℳ ij—ℳ v, by inhalation or subcutaneously.

ANTAGONISTS.—The actions of the nitrite of amyl are antagonized by all those agents which increase the functional activity of the spinal cord and sympathetic — as strychnine, brucine, picrotoxin, digitalis, ergot, belladonna, and, as McCullough has shown, it is an efficient remedy in chloral - poisoning. The opposing action of amyl nitrite and ergot has been demonstrated clinically by Dr. Fancourt Barnes, in cases of hour-glass contraction induced by ergot. This antagonism may not be available, owing to the difference in the rate at which they are diffused, to affect the system.

SYNERGISTS.—All of the motor depressants increase the effects of the nitrite of amyl.

PHYSIOLOGICAL ACTIONS.—The following are the symptoms produced by nitrite of amyl when inhaled : acceleration of the action of the heart ; sudden flushing of the face ; dilatation of the arterioles in consequence of paresis of the muscular layer of these vessels ; a sense of extreme fullness of the brain, with vertigo ; fall in the blood-pressure ; lowering of the temperature ; complete resolution of the muscular system of animal life. The vapor of nitrite of amyl applied directly to the tissues—muscular or nervous—suspends or completely arrests functional activity. Circulating in the blood, it undoubtedly affects most the vaso-motor nervous system and unstriped muscular fiber.

The marked acceleration of the heart (Pick) is in part consecutive, doubtless, to the sudden dilatation of the arterioles, permitting such an increased quantity of the blood to enter these vessels as to require renewed effort on the part of the heart to supply it ; in part also to the paretic state which it induces in the inhibitory apparatus. The great fall in the blood-pressure noted by Brunton, Wood, and Amez-Droz, is also due to dilatation of the arterioles, and consequent diminution of tension in the peripheral vascular system. Dilatation of the retinal vessels, when nitrite of amyl is inhaled, has been ascertained by ophthalmoscopic examination (Aldridge).

On the nervous system of animal life the nitrite of amyl acts as a depressant—impairing motility first, and, at the last, sensibility. It affects both the spinal cord and the nerves, lessening the sensibility to all forms of irritation, and diminishing the reflex functions. It also impairs the contractility of muscle. Death ensues from failure of respiration, and the cerebral functions are unaffected until carbonic-acid poisoning ensues.

Decided lowering of temperature is produced by the nitrite of amyl. This result is no doubt due to the action of this agent on the hæmoglobin, whereby the carrying capacity of the red blood-globules of oxygen is lessened (Gamgee), metamorphosis of tissue is interfered with, and the generation of animal heat is diminished. A peculiar change ensues in the color of the blood as a result of the lessened oxygenation: all the blood of the body assumes a modified venous hue.

A curious fact has been noted by Hoffmann, viz.: the hypodermatic injection of lethal doses of nitrite of amyl produces in rabbits a temporary glycosuria.

THERAPY.—The applications of the nitrite of amyl in the treatment of disease have been deduced from a study of its physiological actions. It is especially indicated when morbid symptoms result from vaso-motor spasm. It has been shown that *epileptic attacks* may be warded off by the inhalation of nitrite of amyl at the beginning of the movement of the *aura*. Patients who have a distinct warning of the seizures should be constantly provided with a small quantity of this remedy in order to practice the inhalation whenever an attack is impending. The mechanism of the action is very simple: the vaso-motor spasm of the cerebral vessels, which is the initial symptom of an epileptic convulsion, is relaxed, and the vessels dilated by the nitrite of amyl.

By the timely inhalation of the nitrite, the *cold stage of an ague* may be aborted, but the hot stage is not modified in any way (Price, Ziegler). This power may be most serviceable in cases of *pernicious intermittent*, the danger of which consists in the extreme depression of the cold stage. The cardiac failure caused by chloral, chloroform, and other heart-poison, and the condition of sudden weakness which may ensue from various causes, in cases of fatty heart, are often remarkably relieved by the inhalation or hypodermatic injection of amyl nitrite.

An attack of *migraine*, of that form characterized by vaso-motor spasm (pallor of the face), may be quickly relieved and sometimes aborted by the inhalation of two or three drops of amyl nitrite.

When there are redness of the face, injection of the conjunctivæ, and fullness of the cerebral vessels, this remedy is contraindicated. Cases of *neuralgia of the fifth nerve*, second division, have been cured by inhalation of amyl, repeated from time to time as the pain required its administration.

Asthma, when purely spasmodic, is usually quickly checked by this remedy. The paroxysms of difficult breathing which accompany emphysema and cardiac disease are not relieved in this way; indeed, the author has known the most serious distress to be produced by the inhalation under these circumstances.

Exaltation of the reflex function of the spinal cord and muscular spasm are morbid states in which good results may be expected from inhalation of the nitrite of amyl. It has been used with success in *tetanus*. It should also be fairly tried in *strychnine-poisoning* and in *hydrophobia*. Michael has administered it in *tinnitus aurium*, a most obstinate and distressing condition, with comparatively good effects: of a group of thirty-three cases, nineteen were distinctly benefited.

Most signal relief has been obtained from the inhalation of amyl nitrite in *angina pectoris*. We owe this important suggestion and practice to Brunton, who had ascertained that when the paroxysm of angina pectoris occurs, a great rise of arterial tension takes place. When the pain, præcordial distress, and anxiety are felt, there should be no delay in the use of the remedy. Some cautions are, however, needed. It may be unsafe when advanced degeneration of the cerebral vessels exists (Anstie). Fatty degeneration of the heart, which is so frequently a cause or an accompaniment of angina pectoris, may also render the use of so powerful a paralyzer of doubtful expediency.

Dr. Mary Putnam Jacobi has found the inhalation of nitrite of amyl very serviceable in *neuralgic dysmenorrhœa*. As an antagonist to ergot, it may prove in a high degree useful, when ill effects are caused by this remedy. Thus, in a case of hour-glass contraction produced by ergot, the inhalation of amyl nitrite procured immediate relief. On theoretical grounds this agent was proposed for the relief of *cholera asphyxia* (Brunton, Gamgee), but the trials thus far made with it have demonstrated its inutility. Owing to the fact, shown by Gamgee, that nitrite of amyl combines with hæmoglobin, Brunton proposes that this remedy, if given at all in cholera, must be administered by the stomach or by subcutaneous injection, and not by inhalation.

Repetition in the use of the nitrite of amyl diminishes its effects, and hence increasing doses are necessary when it is often employed in the same case.

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Nitro-Glycerinum.—*Spiritus Glonoini.* Spirit of nitro-glycerin. Glonoin.

Properties.—Nitro-glycerin is an oily liquid, colorless, or pale yellow, and has the specific gravity 1·60 at 59° Fahr. It burns quietly in the open air, but heated in a close vessel, or subjected to percussion, it explodes violently. It decomposes if long kept. It is very slightly soluble in water, but dissolves freely in alcohol and in ether. The best preparation for administration is the alcoholic solution—one part of nitro-glycerin to one hundred parts of alcohol. The dose of this ranges from one minim to many minims. As the susceptibility to this agent varies greatly, the initial dose should be the smallest. One minim of the one-per-cent solution will give some persons violent headache, while others may take a minim of the undiluted drug without any decided effect.

So much apprehension is felt by patients who have to take this remedy, that the names "glonoin" and "trinitrin" have been proposed for it, and have now come into general use.

Sodii Nitris.—Sodium nitrite.

Potassii Nitris.—Nitrate of potassium. These salts have been proposed and used as substitutes for amyl nitrite and nitro-glycerin. Dose, gr. iij—gr. viij.

Antagonists.—All those agents which increase the reflex activity of the spinal cord and stimulate the vaso-motor system, as strychnine, ergot, digitalis, belladonna, etc., antagonize nitro-glycerin.

Synergists.—Amyl nitrite acts very similarly, and the motor depressants in general promote the actions of nitro-glycerin.

Physiological Actions.—The taste of nitro-glycerin is at first sweetish, but this impression is followed by aromatic pungency. In a few minutes—from three to five—after a small medicinal dose, there are suddenly experienced a feeling of giddiness, tension of the head, with fullness, languor, nausea, and sometimes stomach-pain. Such effects are experienced from a small dose, if the individual taking it is susceptible. It follows, then, that the quantity of nitro-glycerin causing such symptoms must vary in different patients. Dr. Harley experienced these effects after taking fifteen drops. Dr. Fuller experienced some fullness of the head, perspiration, intermittent pulse, and some after-headache, from a dose equivalent to fifty minims of a one-per-cent solution, or a half-drop of the nitro-glycerin itself (Murrell). In some persons a drop or two of the one-per-cent solution will cause dizziness, faintness, a rapid and very weak pulse, perspiration of a rather clammy character; or, indeed, the symptoms may proceed to unconsciousness. Dr. Murrell applied the moistened cork of the bottle containing the solution to his lips, and in a few minutes experienced a tremendous action of the heart and arterial system; his pulse rose to 100 and higher, and he had "a splitting headache" for some time. There is no change in the temperature. Women and the feeble in constitution suffer more decided effects than the robust. Drowsiness comes on, with a feeling of languor, in those on whom the smallest dose acts kindly. With the rapid pulse is a considerable degree of dicrotism. The change in the character of the pulse begins in about six minutes after the dose is taken, and lasts on the whole about one hour. The sphygmographic tracings appended to Dr. Murrell's paper are remarkable for the extent of the excursions of the lever, the abrupt ascent, the sharpness of the summit, and the dicrotic rebound, indicating an extremely low state of the arterial tension. When the heart of a frog is put into a ·75-per-cent salt solution, and two drops of a ten-per-cent solution of nitro-glycerin are added, the heart acts more and more slowly, and presently stops. An alcoholic solution has no effect (Brunton). When injected into the jugular vein of a cat, the nitro-glycerin solution arrests the heart speedily. That the vagus is paralyzed, and the inhibition thus removed from the heart, is proved by the fact that galvanic excitation of the vagus has no effect in restraining the cardiac movements. Changes occur in the blood like those induced by amyl nitrite and the nitrites of soda and other nitrites; that is, the blood assumes a chocolate-color, and probably loses its power of absorbing and conveying oxygen; but its so-called ozonizing function may not be interfered with, since nitro-glycerin does not prevent the guaiac reaction, in which respect it agrees with the other nitrites. The change in the color of the blood is produced slowly when blood is shaken up with some nitro-glycerin outside of the body (Brunton).

In frogs nitro-glycerin causes weakness, tetanus, ending in paralysis; but, in warm-blooded animals, there are convulsive movements, as twitching of the muscles, hiccough, spasmodic breathing, etc. The tetanus in frogs, according to Brunton, is not due to a direct action of the poison on the spinal cord, thus opposing the assumption of Minor, who held that it acts on the medulla. The paralyzing effect of nitro-glycerin appears to be due to an action on the muscles, and also on the motor nerves. When it is applied directly to the muscles, they quickly lose their contractility. The reflex function of the cord is extinguished first in the parts external to the cranium, the cerebral nerves preserving their power to transmit impressions until later. Sensation is destroyed by it as well as motility. Death is due to asphyxia —to paralysis of the muscles of respiration. Notwithstanding the activity of nitro-glycerin, the most serious symptoms are recovered from without detriment. Thus Dr. Murrell narrates several cases in which unconsciousness was produced without any ill results, except some temporary headache.

THERAPY.—Nitro-glycerin is adapted to the treatment of the maladies in which its congener, amyl nitrite, has proved so effective. It has the advantages over the latter of being more permanent, more readily administered, and more sustained in action. In *sea-sickness, reflex vomiting, gastralgia, hepatic colic,* and other painful and spasmodic affections of the digestive tube, it may afford very prompt relief. It was first employed in the treatment of *angina pectoris,* in which it gives as much relief as does amyl nitrite, but the latter should be preferred when the utmost promptitude of action is necessary. The form of the disease requiring this medicine is that characterized by high tension of the peripheral vessels, which is doubtless the condition in the genuine cases of angina pectoris. Very prompt relief may be given to attacks of *hiccough* by this medicine. Some cases of *spasmodic asthma* are much benefited by it. The less there is of structural alterations, the more certain the relief. As the secretions of the mucous membrane of the respiratory tract are increased by it, the cases with deficient secretion are those most certain to be benefited. It should be carefully tried in *whooping-cough* and in *laryngismus stridulus.* There is much to be expected from nitro-glycerin in diseases of the nervous system characterized by heightened reflexes. An attack of *epilepsy* may be aborted by its timely administration, and Hammond finds it as a remedy for this disease second only to the bromides. By preventing the spasm of the vessels and consequent sudden anæmia of the brain, the first and most important event in the series can not occur. It should be fairly tried in *tetanus* and *hydrophobia.* In *neuralgia* of the fifth nerve it has given immediate relief in numerous instances. It is the most appropriate remedy in that form of *migraine,* or sick-headache, in which the vessels are in a condition of spasm, but is not proper in those cases having a flushed face from dilated vessels.

The cold stage of an *intermittent* may be aborted by the timely administration of nitro-glycerin. It promises to be especially useful in the pernicious malarial diseases to prevent the dangerous depression of the cold stage. In these cases its administration should be so timed that the physiological effect of the remedy occur at the onset of the cold stage of the disease. The mechanism of its curative action is obvious. Remarkable results have lately been obtained from this remedy in *acute and chronic Bright's disease* (Robson)—results which the author is able, from personal observations, to confirm. It is well known, of course, that high arterial tension is present; but whether as causative of the renal changes, or a consequence of them, is not known. The apparently constant association of degenerative changes in the renal ganglia with the lesions of Bright's disease, discovered by Da Costa and Longstreth, would indicate that the state of the vessels is a factor in developing the structural alterations. The manner in which nitro-glycerin affords relief, and possibly effects a cure, is thus fully explained. Indeed, all of the curative results obtained from nitro-glycerin must be referred to its action on the vascular apparatus.

The suggestions as to its therapeutical employment above made have been abundantly justified by the experiences gained since the publication of the last edition of this work. The author has now to submit some observations on the utility of trinitrin in cardiac affections. *Pseudo-angina pectoris, fatty heart, and weak heart,* are morbid states that appear from about forty-five onward. Degenerative changes, belonging to advanced life, underlie the attacks of pain with disordered function, and are also responsible, to some extent, for the other condition. Weak cardiac contractions, and damaged vessels, interfere with the nutrition of the body in general, including the muscular substance of the heart. Feebleness of the cardiac contractions lessens the force of the impulsion with which the blood enters the arterioles, and they contract on their lumen as the anæmia increases. Now, trinitrin opposes this state of things. Under its action, the heart contracts more frequently and energetically, the arterioles dilate, and thus the organs of circulation are helped in two modes: in facilitating the distribution of the blood by lessening the pressure in the arterioles at the periphery; and in improving the power of its own muscular tissue, by the increased amount of blood passing into it through the coronary artery. If we add to these good effects the permanent improvement of nutrition by a suitable diet and exercise, we have a satisfactory solution of some of the most difficult problems given us to solve. It should be understood, also, that the improvement of nutrition by increased alimentation is the more complete because, by the action of trinitrin, a much larger quantity of blood is obtained by the tissues, and hence more of the nutritious matters, than would otherwise be available. The author has availed himself of these facts, and has utilized trinitrin in the treatment of *anæmia* in its ordinary form, and in the *pernicious* variety. One of the most common of the therapeutical fallacies of the day is the giving of iron to cure anæmia, for in a large proportion of the cases the iron can not be assimilated. The organs concerned in blood-making may be in a pathological condition, or functionally torpid. Stomachal and intestinal digestion may be in such a state that the ordinary preparation of food-stuffs is too imperfectly performed for the materials to be utilized in blood-making. To cure anæmia, something more is requisite than to give iron. The functional or pathological states that interfere must be removed. When all the digestive and assimilative functions are restored, failure is still encountered by imperfect distribution of the blood. The heart may be feeble and act imperfectly, the peripheral arterioles may contract on their lumen, and thus hinder the passage of the blood. Such is the condition in a large proportion of the cases of anæmia. To bring about a proper activity of the nutrition, it is necessary to restore the organs of circulation, and admit the fullest nutrient supply to all the tissues. It is this function of trinitrin that places it in the front rank of remedies for *anæmia*, for by dilating the arterioles and energizing the heart's action the fullest supply of blood is sent to all the tissues of the body.

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Aconitum.—The tuber of *Aconitum napellus* Linné (Nat. Ord. *Ranunculaceæ*). (U. S. P.) *Racine d'aconit*, Fr. ; *Eisenhutknollen*, Ger.

The Indian aconite-root, or *bish*, is supposed to be more powerful than the root of *Aconitum napellus*, and is preferred for the manufacture of aconitine (Flückiger and Hanbury).

Extractum Aconiti Fluidum.—Fluid extract of aconite. Dose, ♏ j—♏ v.

Extractum Aconiti.—Extract of aconite. Prepared from the leaves. Dose, gr. ⅛ to gr. ss.

Tinctura Aconiti.—Tincture of aconite-root. Dose, ♏ j—♏ v.

Composition.—The principal alkaloid is *aconitia* or *aconitine*, which exists in two forms, crystalline and amorphous, and forms with acids crystallizable salts. The crystalline form of aconitine is soluble in chloroform, ether, and alcohol. Aconite contains also another alkaloid which has received various designations—*pseudo-aconitine*, *napelline*, *nepalline*, etc., which is closely allied to aconitine, and is found in commerce under this name. It is but slightly soluble in chloroform, ether, and alcohol, and it exists also in two forms, crystalline and amorphous. Besides the foregoing, another base has been discovered, to which the name *napelline* has also been given (Hübschmann). This is an amorphous alkaloid, having strong basic properties, soluble in water, chloroform, and alcohol, but not soluble in ether. These basic substances are united with a peculiar acid—*aconitic acid.*

Antagonists and Incompatibles.—Alcohol, ether, ammonia, turpentine, digitalis, heat, etc., antagonize the actions of aconite. In cases of poisoning, the stomach should be evacuated, stimulants administered by the stomach and rectum, and external warmth applied. Digitalis has been used with considerable advantage (Fothergill). The intra-venous injection of ammonia may be practiced, and artificial respiration resorted to. To overcome the depression of the heart's action, which is the capital point, the hypodermatic injection of atropine is indicated. As the chief danger consists in failure of the heart's action, the recumbent position should be strictly maintained.

SYNERGISTS.—All the agents of this group increase the effects of aconite. Cold, fatigue, and all depressing emotions, are also synergistic.

PHYSIOLOGICAL ACTIONS.—A drop of tincture of aconite placed on the tongue excites a warm and pungent sensation, followed by persistent tingling and numbness. Prolonged contact with the skin causes similar effects upon the sensory nerves. During the medicinal administration of aconite in considerable doses, irritation and a sense of constriction of the fauces are experienced. Large medicinal doses produce gastric pain, nausea, and even vomiting. When the gastro-intestinal mucous membrane is in an irritable state, aconite impairs the appetite, hinders the digestion, and causes diarrhœa, and in the normal state of the membrane, increases its secretions and hastens the peristaltic movements.

The systemic effects of aconite follow within a half-hour after its administration. The number and force of the heart-beats are reduced, and the arterial tension is lowered. The action of the skin is increased, and a more abundant urinary discharge takes place. If the quantity has been a full medicinal dose, some muscular weakness, tingling in the tongue, lips, and extremities, are also experienced. The whole duration of the effect is about three hours. When a lethal dose is swallowed, the symptoms begin in from five minutes to a half-hour. In a medical student, who swallowed by mistake a teaspoonful of the tincture of the root, the symptoms began after he had reached the college, having walked from his quarters—the time being about twenty minutes. He experienced an overpowering sense of fatigue in the lower extremities, and he felt, also, great muscular weakness. His eyesight became dim, the globes rather prominent, the pupils dilated. He experienced great dyspnœa, and his respirations were shallow and labored. The pulse was at first slow and small, and at last became imperceptible. The surface of the body, the tongue, and breath, were cold. The skin was covered with a profuse sweat. He was restless, anxious, and sighed frequently ; but he had no stupor or convulsions. There were also decided numbness and tingling in the extremities, and in the tongue and lips. Tactile impressions were very faint, and the sense of pain was greatly reduced, so that he seemed almost unconscious of irritants. His temperature fell 2° Fahr. Under the use of heat, brandy, and ammonia, he revived in the course of six hours, and, on the following day, although weak, there were no indications of the effects of the poison.

Aconite affects the sensory nerves before the motor. It paralyzes first the end-organs, next the nerve-trunks, and finally the centers of sensation in the cord. Aconite also impairs the reflex function of the spinal cord; but this effect is, doubtless, secondary to the sensory paralysis. The power of voluntary movement continues after the cessation of the reflex functions; but it is finally lost. The arrest of motility is due to the action of the poison on the motor centers of the cord, and subsequently on the nerve-trunks.

Aconite, applied directly to the heart, lessens the number and force of its beats, and finally arrests its action in the diastole. The cardiac muscle, after the cessation of its movements, does not respond to galvanic excitation. Aconite lowers the arterial pressure, as well as lessens the force of the heart-beat. From these facts it may be concluded that it is a direct cardiac poison, affecting its ganglia and muscle, and also a sedative to the vasor-motor nervous system. It is also a respiratory poison, in virtue of its paralyzing action on the muscles of respiration; but the action of the heart ceases before the respiratory movements.

Aconite increases elimination by the skin and kidneys. With increased discharge of water, there takes place, also, increased excretion of solids.

THERAPY.—The monopoly by homœopathic practitioners of the use of aconite has aroused a prejudice against it, which has discouraged its employment. Aconite is, however, an antagonist to the fever-process; it is not applicable in accordance with the so-called law of similars. It is used by these quacks because it is a powerful agent which will produce manifest effects in small doses, that may easily be disguised.

The author can quite agree with Dr. Ringer in the statement that aconite is a very valuable medicine, in the class of cases to which it is adapted. It lessens the pulse-rate, lowers arterial tension, diminishes abnormal heat; it therefore antagonizes that condition of the organism known as *fever*. As it also slows the respiratory movements, and thus lessens the amount of work done by the breathing apparatus, it is especially indicated in *inflammatory states of the respiratory organs*. As it diminishes the sensibility of the sensory nerves, it is useful in certain forms of *neuralgiæ*. As it induces muscular weakness and lowers the activity of the reflex functions, it is indicated in morbid states characterized by an excess of motor activity.

Tonsillitis, acute pharyngitis, ulceration of tonsils, when accompanied by fever and elevated arterial tension, are greatly relieved by the use of the tincture of aconite. From a half-drop to one drop every half-hour, until an impression is made on the fever-movement, and then every hour or two, is the best mode of administration. In *acute catarrh* (nasal and faucial), *acute otitis*, and in *acute catarrhal bronchitis*, the best results may be obtained by the use of aconite, as above described. The author's observations entitle him to speak with confidence of the good effects of this remedy in *catarrhal* and *fibrinous pneumonia*. It is more especially serviceable before exudations have taken place, but is not without utility at any stage, provided the inflammatory process continues. It not only abates the symptoms, but it favors the removal of the products of inflammation, by increasing elimination through the skin and kidneys. The use of aconite is not incompatible with the employment of other measures which may be needed; but, generally, in fibrinous pneumonia, aconite is sufficient up to the period of crisis. The author has witnessed excellent results from the use of aconite in small doses frequently repeated (one drop every hour) in lowering the temperature of *phthisis*, especially when new districts of pulmonary tissue are invaded by pneumonitis. For the treatment of *acute pleuritis*, previous to the stage of effusion, no remedies are more effective than aconite and opium. ℞ Tinct. aconiti rad., ʒ ij; tinct. opii deodor., ʒ vj. M. Sig.: *Eight drops in water every hour or two.* If the pain is severe, a larger dose of opium should be administered, when the effect can be maintained by the quantity directed in the above prescription.

Overaction of the heart, with hypertrophy and without valvular lesion, especially if there be present a condition of plethora, is benefited by a quantity of aconite sufficiently large to moderate the cardiac movements.

Aconite is contraindicated in inflammatory states of the gastro-intestinal mucous membrane. It is very serviceable in *acute congestion of the liver* and *hepatitis*: it diminishes the fever, and, by causing free transpiration, lessens the pungent heat of the skin. *Peritonitis* is best treated by a combination of aconite and opium, as described above for pleuritis. Generally, the opium needs to be given in somewhat larger quantity in peritonitis than in pleuritis. In *pelvic peritonitis, puerperal metritis*, and *peritonitis*, aconite is indicated, and is of unquestionable utility, provided there be present a condition of sthenic reaction. A condition of adynamia, on the other hand, always contraindicates the use of aconite.

The simple fevers of childhood, *febricula, ephemeral fever*, arising from various causes, as cold, fatigue, excitement, etc., are best treated by small and repeated doses of aconite. The remedy induces sweating, and then the fever-movement subsides. The hot stage of *intermittents* and *remittent fever*, if any febrifuge is required, may be relieved of its intensity by frequently-repeated doses of aconite. The *continued fevers* are not benefited by this remedy unless a condition of hyperpyrexia is threatened, when aconite may be used in connection with other antipyretic remedies.

Aconite possesses the highest value in the *eruptive fevers*, especially in *scarlet fever*. There are two conditions of this disease especially requiring the use of aconite—the eruptive stage, and the period of desquamation, if, as is usual, a marked rise of temperature takes place at this period of the disease. Several important purposes are subserved by the use of this remedy: it lowers the fever-heat, favors the action of the skin and kidneys, and checks the nasal, faucial, and aural inflammations, which constitute such troublesome complications and sequelæ. The particular utility of aconite in *measles* consists in its power to arrest the catarrhal pneumonia, one of the most serious complications of this disease. We have no remedy more useful in *erysipelas*—idiopathic, so called, and not arising from trauma; but, on the other hand, Ringer describes an apparently erysipelatous inflammation following vaccination, which is quickly cured by aconite. According to the author's observations, it is facial erysipelas which is most decidedly benefited, and cases characterized by sthenic reaction. When there is a state of adynamia present, the eruption being dusky and the cutaneous circulation languid, belladonna is preferable to aconite. When, in *acute rheumatism*, there are much heat and a dry skin, instead of the usual sweating, aconite is very serviceable. It affords very considerable relief in *muscular rheumatism* when there is much fever.

In acute inflammation of the *cerebral* and *spinal meninges*, and in *cerebro-spinal meningitis* before effusion has taken place, aconite is as serviceable as in other acute inflammations. It is generally advisable to combine opium with it, especially in cerebro-spinal meningitis. In *acute maniacal delirium*, and in mental disorders generally, when there is much motor activity, with vascular excitement and increased arterial tension, aconite is useful, but is not so effective as gelsemium. Aconite renders important service in the *active form of acute cerebral congestion*.

Neuralgia, when accompanied by arterial excitement and muscular spasm, is relieved by aconite; but generally the neuralgias are much more successfully treated by hypodermatic injections and galvanism.

It is asserted by Ringer, and also by Phillips, that sudden *suppression of the catamenial flow*, caused by cold, can be relieved by aconite, in drop-doses of the tincture every half-hour or hour. The author can assert that this remedy has a high degree of utility in *congestive dysmenorrhœa*, occurring in plethoric subjects. These are cases, also, in which gelsemium is so undoubtedly beneficial.

Aconitine in Trigeminal Neuralgia.—Remarkable results have lately been obtained by the use of Duquesnel's aconitine in this malady. The following formula is proposed by the New York Therapeutical Society: ℞ Aconitinæ (Duquesnel's), gr. $\frac{1}{10}$; glycerini, alcohol., āā ʒ j;

aquam menthæ pip., ad ℥ij. M. Dose, a teaspoonful. The dose is sometimes very slowly and cautiously increased to ⅛. Although it does not succeed in all cases of tic-douloureux for obvious reasons, it relieves remarkably in others (Seguin).

Napelline.—Duquesnel has lately rediscovered (?) a principle to which he has applied the name *napelline.* Its physiological actions have been studied by Laborde. He finds it weaker than aconitine, and was able to administer without ill results from a half (½) grain to three fifths (⅗) of a grain. It possesses valuable hypnotic properties, and it is proposed to use it as a substitute for opium and chloral. On trial it proved to be an effective remedy in *neuralgia,* and as a sleep-producing agent in cases of *wakefulness, mental excitement,* and allied conditions. If further investigations confirm those observations, it will be a valuable addition to the materia medica.

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Taylor, Dr. A. S. *On Poisons,* third London edition, p. 747.

Van Praag, Dr. L. *Archiv für path. Anat.,* vii, p. 438.

Veratrum Viride.—American hellebore. The rhizoma and roots of *Veratrum viride* Solander (Nat. Ord. *Liliaceæ*).

Extractum Veratri Viridis Fluidum.—Fluid extract of veratrum viride. Dose, ♏ij—♏v.

Tinctura Veratri Viridis.—Tincture of veratrum viride. Dose, ♏ij—♏v.

Veratrina.—Veratrine. An alkaloid or mixture of alkaloids, prepared from the seeds of *Asagræa officinalis* Lindley (Nat. Ord. *Liliaceæ*). Is pulverulent, grayish-white, inodorous, but very irritant to the nostrils. It has an acrid, bitter taste, causing a sensation of tingling with numbness in the tongue. It is very slightly soluble in water, but readily and wholly dissolved by alcohol. It has an alkaline reaction.

Oleatum Veratrinæ.—Oleate of veratrine. Veratrine, 2 grm.; oleic acid, 98 grm. (For external use.)

Unguentum Veratrinæ.—Veratrine ointment. Veratrine, 4 grm.; olive-oil, 6 grm.; benzoinated lard, 90 grm. (For external use.)

Composition.—Veratrum album, veratrum viride, and veratrum sabadillæ, correspond closely in chemical composition, and the first two in botanical characteristics. Sabadilla is only used as the source of the alkaloid *veratrine*. The alkaloids of veratrum album are *jervine* and *veratralbine* (Mitchell). Veratrum viride contains two alkaloids also—*jervine* and *veratroidine*. The alkaloid jervine is found in both plants, is the same in chemical action and in physiological effects, and may, therefore, be considered identical. There are very close affinities between the veratralbine of Mitchell and the veratroidine first discovered by Bullock, but they are not the same; they differ as respects their chemical relations, and also in physiological properties, veratralbine being much more powerful than jervine and veratroidine. Veratrum album and veratrum viride contain abundance of soft resin, which, when pure, is nearly, if not quite, inert. As the alkaloid jervine is with difficulty separated from the resin, it is probable that the physiological activity, ascribed to the resin by some observers, is really due to the presence of the alkaloid.

Antagonists and Incompatibles.—The effects of veratrum viride on the heart are counterbalanced by alcoholic stimulants, opium, and ammonia. When dangerous symptoms are produced, the recumbent position should be enforced, alcoholic stimulants should be administered by the stomach and rectum, and dry heat should be applied to the body. Ammonia may also be given by the stomach or by intravenous injection, and, if nausea and vomiting persist, morphine may be administered subcutaneously. The tincture of opium, in stimulant doses, may be prescribed with the alcoholic stimulants.

Synergists.—The vaso-motor depressants—tobacco, lobelia, aconite, etc.—are synergistic. Blood-letting, hæmorrhage, purgatives, and all agencies which diminish vital power, increase the effects of veratrum.

Physiological Effects.—In the remarks which follow, veratrum viride only is referred to.

Applied to the skin, veratrum viride excites redness and heat, and, to the Schneiderian mucous membrane, it causes violent sneezing. It is a prompt and efficient emetic, but its operation is accompanied with intense nausea and depression, and the vomiting is often violent and persistent. The contents of the stomach are at first evacuated, and afterward of the gall-bladder, so that it has been supposed to possess the power to increase the secretion of bile. It does not generally purge, but occasionally profuse watery evacuations have been produced by it, and rarely severe hypercatharsis. Its alkaloids enter the blood with facility. The power which veratrum viride has to affect the cardiac movements and the vascular tonus is its most characteristic property. It lowers, in a remarkable manner, the number and force of the cardiac pulsations. The pulse may be reduced to fifty, forty, or even thirty-five per minute, and its force correspondingly diminished. According to Linon, the arterial tension is raised, as shown by the sphygmograph. By very careful administration, this reduction in the pulse-rate may sometimes be accomplished without inducing nausea and vomiting, but usually vomiting can not be prevented when the remedy is pushed to this extent. When the pulse is reduced very decidedly, the patient being in the recumbent posture, a change to the erect position at once alters its character, and it becomes extremely rapid, thready, and feeble.

Very great depression of the powers of life is produced by large doses. The action of the heart becomes exceedingly weak, the pulse almost indistinguishable, the vomiting and retching extreme, the surface of the body cold and covered with a cold sweat, the temperature reduced. There are also produced faintness, dimness of sight, dilatation of the pupils, giddiness, great muscular weakness, shallow and slow respiration ; sometimes somnolence, coma, and insensibility, with stertorous breathing. Notwithstanding the very formidable symptoms produced by large doses, fatal results have been extremely rare. An ounce of the tincture has been swallowed without causing death (Norwood). The prompt emesis which it produces is probably the explanation of its lethal inactivity ; for, in the act of vomiting, the medicine is ejected with the first matter from the stomach. Suspension of the medicine and free stimulation quickly remove the most alarming symptoms of depression.

The experimental investigations into the actions of jervine and veratroidine, made by Wood, Peugnet, and others, have shown that the physiological actions of veratrum viride are the sum of the actions of the alkaloids. The nauseating and emetic qualities of the drug are due, chiefly, to veratroidine, and to a slight extent to the resin. Both alkaloids depress the functions of the spinal cord, and destroy its reflex activity ; but they do not impair the excitability of the nerves, nor the contractility of muscles. Veratroidine, according to Wood, first stimulates the inhibitory cardiac nerves to an extraordinary extent, and afterward paralyzes them ; but the evidence which he adduces in favor of the singular statements on this point are far from satisfactory. Both alkaloids lower the blood-pressure, by diminution of vaso-motor tonus, and paralyze the cardiac muscle, and probably also its contained ganglia. They cause death by asphyxia—by paralysis of the muscles of respiration. The cerebral effects which have been noted in man, and the convulsions in animals, are doubtless due to the accumulation of carbonic acid in the blood.

Therapy.—The best preparation for administration is the tincture. As the therapeutic properties of veratrum viride depend, chiefly, on the jervine, an attempt may be made in the future to supply this alkaloid in sufficient quantity for administration ; but, at present, the processes involved in its preparation are too intricate and expensive. As the effect of veratrum viride quickly reaches its maximum, if it be desired to maintain the pulse-rate at a constant level, the doses must not be at a longer interval than two hours. The effect must be maintained by increasing doses, if necessary, and the recumbent posture must be rigidly enforced.

The emetic property of veratrum viride is never applied in practice ; too much depression is produced by it. The chief use of this agent is to depress the action of the heart and to lower the vaso-motor tonus. In simple *hypertrophy of the heart*, without valvular lesion, it diminishes the overaction and thus gives relief to the most distressing symptom. The *irritable heart*, so frequently found associated with and dependent on the excessive use of tobacco, on mental excitement and irascibility of disposition, and on overstrain, is relieved by this remedy, provided no valvular lesions coexist. The *hypertrophy of the cardiac muscle*, and the *abnormal arterial tension*, which accompany the chronic form of albuminuria, are alleviated by veratrum viride. Moderate doses of the tincture (five drops *ter die*) usually suffice in these cases. When there are valvular lesions, and when the cardiac muscle is enfeebled from any cause, this agent is inadmissible.

Excellent results are sometimes obtained in *aneurism* by the use of veratrum viride. In the various surgical expedients for the cure of aneurism (forced flexion, compression, ligation), this remedy, used to depress the circulation, renders an important service, by lessening the force with which the blood is propelled, and the number of the cardiac contractions. In this way, coagulation of the blood in the aneurismal sac is greatly favored. In the case of large internal aneurisms—of the innominata, aorta, etc.—veratrum viride is a powerful adjunct to rest and other means of treatment. Some precautions are necessary, however, in the administration of this remedy. As the utmost slowing of the circulation consistent with safety may be required, a sufficient quantity of the tincture must be administered to accomplish this object, and the effect produced is the only measure of the amount to be given. The result must be accomplished, if possible, without causing vomiting. The patient should, therefore, remain absolutely in the recumbent posture, and a little opium should be prescribed with the veratrum viride. *Active hæmorrhage*, occurring in the plethoric, is sometimes stopped by full medicinal doses of this drug.

There can be no doubt that veratrum viride renders an important service in *acute parenchymatous congestion*—of the brain, lungs, liver, and other organs. Its utility ceases when exudations have taken place : its action is confined to the influence which it has in diminishing the blood-supply to the affected organs. The changes produced by inflammation are in no wise affected by veratrum viride. Much that is extravagant has been written in regard to its curative influence in *pneumonia*, but we need not be surprised at this, when we reflect that our knowledge of the natural history of this disease is only of recent origin. Those who knew nothing of the period of crisis of pneumonia naturally attributed the defervescence of temperature to the effect of the remedy. It is not to be denied that in the very incipiency of pneumonia, before fibrinous exudation has taken place, veratrum viride, by lessening the amount of blood circulating in the lungs, may render an important service, but when hepatization occurs its good effects cease. The same observations are true of other parenchymatous inflammations, and equally so of serous inflammations.

Veratrum viride has been much extolled as a remedy for reducing the pulse-rate and the temperature in *typhoid and other fevers* (Norwood). It is true, these effects may be procured by it, but that any influence is exerted in this way, over the course and duration of a fever, seems highly improbable. The chief dangers in fever being the occurrence of cerebral or cardiac paralysis due to the persistent elevation of the temperature, it is unwise to use a powerful cardiac depressant, although it has the power to lower the temperature somewhat. There is, however, a condition of things arising in the course of fevers —viz., *delirium ferox*—in which, when dependent on arterial excitement, much good may be accomplished by the use of veratrum viride.

The excitement of *acute mania*, of *maniacal delirium*, and other forms of mental disorder in which a condition of cerebral hyperæmia may be supposed to exist, is successfully combated by veratrum viride. In a private communication, Dr. Sullivan, of San Francisco, informs me that this agent (ʒ ss of the fluid extract every fifteen minutes until nausea or vomiting ensues) is "*invaluable in puerperal convulsions.*" Barker, in his "Puerperal Diseases," had already called attention to its utility, and Boyd confirms the previous observations. Increasing experience adds to the testimony regarding its exceptional value in the relief of this formidable malady.

Veratrine is used only externally, and for the relief of *neuralgia, headache, myalgia*, etc. The official *unguentum veratriæ* is the form in which it is employed—a small quantity being rubbed in over the seat of pain.

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Peugnet, Dr. Eugène. *The Medical Record*, May, 1872.

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Pulsatilla.—Pasque-flower. The herb of *Anemone pulsatilla* and *Anemone pratensis* Linné (Nat. Ord. *Ranunculaceæ*), collected soon after flowering. (U. S. P.) *Pulsatille*, Fr.; *Küchenschelle*, Ger.

Preparations.—There are no official preparations. The tincture is the form usually employed in medical practice, the dose of which varies from one minim to twenty minims. A fluid extract, made in accordance with the general formula, may also be prepared.

Composition.—The peculiar powers of the plant depend on the presence in it of an alkaloid—*anemonine*, a camphor. Anemonine crystallizes in prisms—the regular rhombic system—and is hardly at all soluble in cold water and in alcohol (Husemann). Pulsatilla also contains a peculiar acid—anemonic acid.

Antagonists and Incompatibles.—The caustic alkalies, tannic acid, and the metallic salts generally, are chemically incompatible. From the physiological standpoint, pulsatilla is antagonized by alcohol, by opium, digitalis, etc.

Synergists.—The effects of pulsatilla are promoted by the paralyzers, especially by the other members of the same family—notably, by aconite, veratrum viride, etc.

Physiological Actions.—The local effects of pulsatilla (the fresh plant) are those of an irritant; and, after prolonged contact, even caustic effects are produced. Applied to the tongue, it gives rise to tingling, burning, followed by numbness—effects very similar to those caused by aconite. On the intestinal mucous membrane it has very pronounced irritating effects. The active principles diffuse into the blood with facility. Depression of the heart's action, lowering of the arterial tension, and declination of temperature, are caused by pulsatilla. It is a paralyzer of motility and sensibility, but, as respects the motor functions, it is not known whether it impairs the contractility of muscle or the irritability of nerve; and, as respects sensation, it has not yet been determined whether the lessened sensibility is due to an influence which this remedy has on the spinal cord, on the nerve-trunks, or on the peripheral expansion—end-organs of the sensory system. Dilated pupils, hebetude of mind, stupor, coma, and convulsions, are cerebral symptoms which occur after a lethal dose has been administered. These cerebral effects may be due to a primary action of pulsatilla on the brain, or to the carbonic-acid poisoning and the anæmia. When the action of the heart and the respiration are very feeble, carbonic acid accumulates in the blood, and an extreme degree of cerebral anæmia ensues. Coma, convulsions, and insensibility, are natural effects of these causes. Nothing is positively known as to the time and mode of elimination of anemonine, but it is probable that excretion takes place by the kidneys.

The production of any given physiological effect will, of course, depend on the genuineness of the drug. The active principles are volatile, and often disappear in the process of desiccation.

THERAPY.—Owing to the irritating action of pulsatilla, it is not suited to the treatment of gastro-intestinal disorders, especially when a state of inflammation exists. Notwithstanding this local irritant effect, homœopathists employ it for the relief of dyspepsia and the accompanying mental symptoms; but, in coming to conclusions as to its curative value, they calmly ignore the natural history of these maladies.

Pulsatilla is adapted to the treatment of *acute inflammation of the nasal, faucial, laryngeal, and bronchial mucous membrane*—acute catarrh. It is not proper in those cases when accompanied by gastro-intestinal disturbance. It is clearly useful in *acute inflammation of the cerebral and spinal meninges.*

It is used by the homœopathists in the treatment of catarrhal ophthalmia, by internal and local applications; and they hold that it is very efficacious in certain diseases of the uterus, on which organ they suppose it to have a special or specific action. *Sudden arrest of the menstrual flow*, whether caused by moral emotion or by cold, may be relieved, and the effects prevented, by pulsatilla. As aconite is very useful under the same circumstances, it may be assumed that good results may be had by the administration of pulsatilla.

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HUSEMANN, DRS. AUG. UND THEOD. *Die Pflanzenstoffe*, p. 795.
PHILLIPS, DR. CHARLES D. F. *Materia Medica and Therapeutics*, p. 17.

Grindelia.—The leaves and flowering tops of *Grindelia robusta* Nuttall, and of *Grindelia squarrosa* Duval (Nat. Ord. *Compositæ*).

PREPARATIONS.—*Extractum Grindeliæ Fluidum.*—Fluid extract of grindelia. Dose, ♏ x—ʒ j.

Extractum Grindeliæ.—Extract of grindelia. (Not official.) Dose, gr. j—gr. v.

COMPOSITION.—An alkaloid with basic properties has been isolated (Rademaker), but its chemical relations have not been fully made out. The plant contains also a volatile oil, and a resin, to which its physiological activity is doubtless in part due.

ANTAGONISTS AND INCOMPATIBLES.—Water precipitates the oleoresin. The mineral salts and caustic alkalies are chemically incompatible. Opium, the cerebral stimulants, alcohol, strychnine, picrotoxin, etc., are opposed as respects the physiological actions.

Synergists.—All motor depressants increase the actions of grindelia.

Physiological Actions.—The taste of grindelia is rather pungent, even acrid, and in the stomach it excites a sensation of warmth. The local stimulant effect is such that it promotes the appetite and digestion; but, if too long continued, or in too great quantity, it excites gastric uneasiness. Grindelia slows, somewhat, the heart and respiratory movements. When administered in sufficient quantity, decided cerebral effects are produced. It dilates the pupil and induces sleep. During this condition of hypnotism, the general cutaneous sensibility is much reduced, and reflex movements become sluggish. Motility is also affected, the paresis beginning in the hind extremities. Its toxic powers are by no means great, two drachms of the fluid extract being required to induce sleep in small rabbits. It affects other warm-blooded animals, and also frogs, in the same way. When death ensues, it is from paralysis of the muscles of respiration. Elimination takes place by the pulmonary mucous membrane, and chiefly by the kidneys.

Therapy.—The most important uses of grindelia, thus far developed, are in the treatment of the *respiratory neuroses.* Its utility in the treatment of *asthma*, especially the so-called *spasmodic asthma*, is certainly great; few cases fail to be relieved at once. Besides the stomach administration, it may be given in the form of fumes, according to the following plan: The plant is steeped in a saturated solution of nitre, dried, when it may be ignited on an ordinary tin plate, the patient inhaling the fumes as they arise, or the fumes in the air of a small, closed apartment. This preparation may also be rolled into cigarettes, and smoked with or without the addition of tobacco, stramonium, lobelia, etc. The fluid extract of grindelia may be incorporated with other asthmatic remedies, in an extemporaneous prescription. For example: ℞ Ext. grindeliæ fluid., ℥ ss; ext. lobeliæ fl., ʒ ij; ext. belladonnæ fl., ʒ j; potassii iodidi, ʒ iij; glycerini, ℥ iij. M. Sig.: *A teaspoonful, as necessary.*

Cough by imitation and habit, *whooping-cough*, and the *spasmodic difficulty of breathing* which accompanies various pulmonary and cardiac diseases, *hay-asthma*, etc., are helped by grindelia. It is also an effective remedy for *bronchitis*, after the subsidence of acute symptoms; for *chronic bronchitis* and *bronchorrhœa*, and for the bronchitis of *emphysema.*

Besides the above diseases for which grindelia has been used with success, it will prove advantageous in *chronic pyelitis*, *chronic cystitis*, etc. In these diseases local application of the oleo-resin takes place all along the urinary tract.

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Fiske, Dr. H. M. *The Pacific Medical and Surgical Journal.*
Rademaker, Dr. C. J. *Louisville Medical News.*

Phytolacca.—*Phytolaccæ fructus.*—The fruit of *Phytolacca decandra* Linné (Nat. Ord. *Phytolaccaceæ*). (U. S. P.) Poke-berries.

Phytolaccæ radix.—The root of *Phytolacca decandra*—poke-root.

Preparations.—*Extractum Phytolaccæ Fluidum.*—Fluid extract of phytolacca. Dose, ♏ v—ʒ j.

Tinctura Phytolaccæ.—Tincture of phytolacca. Dose, ♏ x—ʒ j. (Not official.)

Composition.—Claussen has obtained a neutral principle, which he has named *phytolaccin*, but this should not be confounded with an impure resin called by the eclectics "phytolaccin." Claussen's *phytolaccin* occurs in silky, shining crystals, soluble in alcohol and ether, but not in water. A peculiar acid, *phytolaccic acid*, has also been found in the berries by Terail. It is uncrystallizable, but soluble in water and in alcohol.

Antagonists and Incompatibles.—Alcohol, ether, opium, digitalis, etc., oppose the action of phytolacca.

Synergists.—All depressing agents, the paralyzers, and emetics, contribute to the effects of phytolacca.

Physiological Actions.—Poke is nauseant and emetic, and these effects occur, whatever may be the mode of administration. The emesis does not occur at once ; there is a slowly-accumulating anguish ; vomiting does not result for an hour, and the vomiting is accompanied with great depression. Rutherford has shown that the eclectic preparation *phytolaccin* has decided cholagogue property—ranking, indeed, among the most effective of the agents influencing the flow of bile.

Phytolacca lowers the rate of cardiac movement and the respiration, but does not alter the rhythm. It is a paralyzer, the loss of power occurring first in the hind extremities. The impairment of motility is not due to an action of this agent on the motor nerve or on the muscle —for the irritability of the nerve and the contractility of muscle remain unaffected when a lethal dose of phytolacca has been given. The action is on the spinal cord, chiefly on the medulla. In rabbits, violent trembling occurs, and convulsions, partly tonic, partly clonic, are produced. Death ensues from paralysis of respiration ; for in frogs, when all signs of life have ceased, the heart is found to be in action, on opening the chest. In cases of accidental poisoning, convulsions of a tetanic character have been observed. Elimination takes place chiefly by the kidneys.

Therapy.—Poke has been proposed as an emetic, but the slowness of the action, and the great depression of the powers of life which it causes, have prevented, and will ever prevent, its employment for this purpose.

Alterative powers have been ascribed to it, and cases supposed to be malignant have been cured; but these results were probably instances of the *post* rather than the *propter hoc.* Ulcers, cutaneous diseases, and ophthalmia, are maladies which have been reported cured. Fenner reported a case of *granular conjunctivitis* cured by it, and in the same issue of the journal there is an editorial note, affirming the remarkable powers of the remedy in this disease. If it really does cure this disease when given by the stomach, poke is a remedy of extraordinary value. The evidence is strong that phytolacca does possess considerable power to promote the healing of varicose and other *ulcers of the leg* (Tidd). A soft extract is spread on muslin, and kept applied to the surface of the ulcer. Obstinate *eczema* has been cured in the same way. The pain and inflammation of *burns* may be assuaged by the same application, and the healing greatly facilitated. How far the effect is merely mechanical does not appear.

It has long been known that phytolacca is a serviceable remedy in *chronic rheumatism.* But the therapeutical application of this remedy most deserving of consideration is the treatment of *inflamed breasts.* There seems to be no reason to doubt that phytolacca possesses the remarkable property of arresting an inflammation of the mamma, and preventing suppuration. For this purpose the fluid extract may be given internally, and the solid extract spread on a cloth and kept applied to the breast which is the seat of the inflammation. The possession of this property to prevent suppuration in the breast implies the existence of the same property in threatened suppuration in other glandular organs. As the fact is entirely empirical, and rests on no physiological action of the drug, it can only be determined by further trials whether it will check suppuration elsewhere.

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Ailanthus.—The bark of *A. glandulosa*, a well-known and abundant shade-tree. (Unofficial.)

Preparations.—Fluid extract. Dose, ♏ x to ʒ j. Bark, gr. x—ʒ j.

Composition.—The most important constituent is the oleo-resin. It contains, also, a volatile oil, which is extremely diffusible and powerful, and a bitter principle.

Actions and Uses.—The taste is bitter and somewhat acrid. It is strongly nauseant, and the nausea is accompanied with weakness, vertigo, and cold sweating. It possesses decided purgative property, the stools being large and watery. It has considerable power as a vermifuge, and is effective when employed against tænia. The action of the heart is at first increased, but is subsequently slowed, the pulse becoming small and weak. Respiration is similarly affected, and death ensues in animals by paralysis of the muscles of respiration.

On the brain and nervous system ailanthus acts as a paralyzer, the loss of power beginning in the hind extremities. The paralyzing action seems to depend on the volatile oil, while the purgative and anthelmintic effects are possessed by the oleo-resin.

THERAPY.—The most important application of ailanthus is in the treatment of *tape-worm*. For this purpose the oleo-resin, or, better, a decoction of the fresh bark (ʒ j—℥ iv), may be used. The oleo-resin has the advantage in being a permanent preparation, whereas the bark loses its strength in the process of drying.

Agaricin (*Agaric Acid*).—Obtained from *Agaricus albus*. Crystallizes in needles. Dose, gr. $\frac{1}{12}$ to gr. $\frac{1}{2}$. Given in pill form. It is an efficient remedy for pathological sweating, but rather slow in action, beginning to have an effect in six to ten hours. It may cause nausea and diarrhœa, when it should be combined with a little opium.

Muscarine.—The alkaloid of *Amanita muscaria*, the fly-fungus.

PROPERTIES.—Muscarine is an alkaloid with strong basic properties, and combines with acids to form salts. It has the consistence of sirup, is without odor, free from taste, and is readily soluble in water and in alcohol, but is insoluble in ether and in chloroform.

As muscarine is but slightly irritating to the tissues, it may be used subcutaneously. The dose ranges from one eighth of a grain to two grains.

ANTAGONISTS.—The actions of muscarine are antagonized by atropine (Schmiedeberg and Koppe), by digitaline (Böhm), and by eserine (Prevost). By atropine it is antagonized at all points. When the heart is arrested by muscarine, it possesses the capability of again renewing its action under the influence of a large number of agents, but atropine possesses this property in the highest degree (Alison). Muscarine arrests the heart in diastole by stimulating the intracardiac inhibition apparatus—atropine paralyzes this apparatus (Prevost) ; muscarine causes intense dyspnœa by inducing strong contraction of the pulmonary arteries—atropine relaxes this spasm, unloads the right cavities of the heart, and respiration is resumed ; muscarine lowers, atropine raises the blood-pressure ; muscarine tetanizes the muscular layer of the intestine—atropine induces a paresis of the same ; muscarine increases the secretions of liver, pancreas, and intestinal mucous membrane—atropine arrests these secretions ; muscarine stops the renal secretion—atropine restores it; muscarine causes sweating, salivation, and lachrymation—atropine dries them all; muscarine contracts the pupil—atropine dilates the pupil. For the quantity producing a given physiological effect, the power of the two agents is very unequal, atropine being much stronger. An atropinized eye dilated to a certain point will not be contracted by the quantity of muscarine sufficient when unopposed to induce a marked degree of myosis; but a much larger quantity may overcome the atropine. The same fact is true throughout the whole range of their antagonistic action.

In frogs poisoned by digitaline, the cardiac movements recommence and are maintained for hours by the application of a solution of muscarine. The same fact is true of tobacco and physostigma: the heart arrested by these agents recommences movements when muscarine is applied, and *vice versa.*

Synergists.—The motor depressants synergize some of the actions of muscarine. A close correspondence exists between pilocarpine and muscarine. They both cause nausea, diarrhœa; muscarine at first quickens then slows, and pilocarpine quickens the pulse; they both flush the face and produce free perspiration and salivation; they both cause frontal headache; both contract the pupil; and both diminish the urinary secretion. They differ in some respects, but chiefly in the extent of their action, or quantitatively. Pilocarpine causes more perspiration and salivation; muscarine produces decidedly more active intestinal movements. Pilocarpine diminishes the urinary secretion, but muscarine may arrest it entirely. Pilocarpine slightly contracts the pupil; muscarine contracts the pupil more decidedly, but when applied to the eye directly, dilates the pupil. Pilocarpine always quickens the pulse, muscarine slows the pulse.

Physiological Actions.—The salivary secretion in a large proportion of subjects is much increased. A feeling of constriction of the neck, nausea, and vomiting, and more or less abdominal pain, are produced by it, whether administered by the stomach or subcutaneously (Brunton). The pancreatic and biliary secretions are notably increased after the injection of some milligrammes into a vein (Prevost). This increase of these secretions took place as well between as during digestion. The intestinal mucus is also greater in quantity than normal, and it may be streaked with blood (Schiff). The intestines are thrown into active contractions, tetanized, rather than merely stimulated into more frequent vermicular movements. Under ordinary medicinal doses in man, the bowels are relaxed and the character of the evacuations altered, doubtless, because of the much greater quantity of the biliary and pancreatic secretions poured out. The increased movement of the intestines is accompanied by considerable colic-like pain.

Muscarine enters the blood promptly, whether introduced through the stomach or subcutaneously. It is a cardiac poison. A very minute quantity—a mere trace—applied to the frog's heart, arrests its movements. As Schmiedeberg and Koppe first demonstrated, it arrests the heart in the diastole, and does not impair the irritability of the heart-muscle, for, on irritation of the heart by mechanical, chemical, or electrical means, it again contracts. If the dose is short of lethal, the heart is merely slowed, the number of pulsations being reduced ten, twenty, or even forty beats per minute. Section of the vagi does not affect this result. The action is due to stimulation of the intracardiac inhibitory apparatus. By Alison it is referred to over-excitation of the cardiac terminals of the vagus, and coincident diminution in the activity of the sympathetic fibers. When the effects of muscarine are manifested by a diminution of the pulse-rate, the blood-pressure begins to decline. At first the vessels contract, but this is soon succeeded by dilatation (Bogosslowsky). With the slowing of the heart and dilatation of the vessels, the blood accumulates in the periphery, and the blood-pressure is consequently reduced one half.

Disturbances of respiration occur with the other defined symptoms. The breathing grows more labored with the increasing effects of the agent, and presently an intense dyspnœa supervenes (Schmiedeberg). The mechanism of the labored respiration is obvious enough. Such a strong contraction of the pulmonary vessels ensues as to greatly diminish the quantity of blood circulating in the lungs, with the result of over-distention of the right cavities of the heart. Hence it follows that the state of the blood is impaired by the lack of oxygen and the retention of carbonic acid, and to these factors must be attributed in part the cyanosis and asphyxia. These modifications of the respiration occur after preliminary section of the vagi. The almost arrested oxygenation of the blood, the languid circulation, and the profuse perspiration, are the factors which cause a lowering of the temperature. By Schmiedeberg and Koppe there are recognized three conditions of the body-heat: 1. A slight elevation, which is by no means constant, and very transient, coming on in about two hours after the dose—a small one—has been taken; 2. A depression of one or two degrees, succeeded presently by the normal temperature, produced by a full medicinal dose; and, 3. A very pronounced lowering of the temperature from a fatal dose.

By the internal administration of muscarine the pupil contracts, and, singularly enough, by direct application, dilates. There are other examples of this paradox. Vision is disturbed by alteration of the accommodation apparatus by spasm. The myosis depends on stimulation of the circular fibers of the iris or of the third nerve, and not on paralysis of the radiating fibers, or of the sympathetic filaments.

Muscarine produces abundant perspiration, and, indeed, stimulates this function only less powerfully than pilocarpine. In most cases the saliva is correspondingly increased. The two functions do not always act together with the maximum energy, and one may be powerfully affected, while the other is quiescent. Lachrymation is nearly constant, and the nasal mucus is more abundant than in the normal state. Thus, while all other secretions and excretions are increased by muscarine, it is remarkable that the urine should be decidedly lessened in amount, even suppressed. In eight experiments made with great care, Prevost found that the injection of muscarine into a vein diminished the urinary secretion, and, indeed, almost stopped it when the dose was large. The elimination of muscarine takes place by the kidneys. The best evidence that it is excreted unchanged is the physiological action of the urine. The urinary secretion of an animal poisoned by muscarine will poison another animal to whom it is administered, and its powers are transmitted with little diminution through several.

THERAPY.—The applications of muscarine to the treatment of disease are yet in their infancy. The physiological effects indicate the direction of the remedial applications. As muscarine stimulates so powerfully the muscular fiber of the intestine, and the secretions of the pancreas, liver, and intestinal mucous membrane, it ought to be very serviceable in cases of constipation with torpor of the organs concerned in digestion. When *constipation* is due to paresis of the muscular layer of the bowel and to deficient secretion, this remedy will probably relieve it. In the treatment of intestinal torpor and deficient secretion, muscarine may be combined with other remedies, as atropine and strychnine, which act on the organs concerned, or with cathartics and cholagogues : ℞ Muscarinæ, gr. iv ; ext. belladonnæ, ext. nucis vomicæ, āā gr. iij ; euonymin, ʒ ss. M. Ft. pil. no. xij. Sig. : One pill morning and evening. When the digestion of the starches and fats is imperfect, it is strongly indicated. In *catarrh of the duodenum*, and in *catarrhal jaundice*, it ought to be very efficient. In these maladies, the remedy should be administered frequently and in small doses : ℞ Muscarinæ, gr. j ; aquæ, ℥ j. M. Sig. : A teaspoonful every three hours. It is probable, also, that it will prove useful in *recent hæmorrhoids* due to congestion of the portal circulation. It promises well as a remedy for the removal of *inflammatory effusions and exudations*. It ought to afford prompt relief at the onset of a *common cold*, an *acute bronchitis*, *hay-asthma*, etc. As muscarine produces strong contraction of the pulmonary capillaries, it ought to be useful in *pulmonary hæmorrhage*, in incipient *congestion of the lungs*, etc. Under such circumstances the combination with digitalis ought to be especially effective, for, while digitalis will aid the curative action on the pulmonary vessels, it will, at the same time, antagonize the cardiac depression caused by muscarine. It is contraindicated in affections of the air-passages when secretion is in excess. For the *night-sweats of phthisis* fly-fungus has long been used, and a similar fungus is commended by Trousseau ; but it has not been as successful in the hands of Murrell as some other agents, although capable, sometimes, of very good results. Muscarine is of doubtful propriety, if not positively contraindicated, in renal affections characterized by deficiency in the excretion. On the other hand, it ought to be of signal service in *diabetes insipidus* and in saccharine diabetes. It has been used successfully to arrest the secretion of milk.

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Aspidosperma (Quebracho).—The bark of *Aspidosperma quebracho blanco* Schlechtendal (Nat. Ord. *Apocynaceæ*).

PREPARATIONS.—*Tincture.*—One part of quebracho to five parts of alcohol. Dose, ♏ v—ʒ j. (Not official.)

Extractum Aspidospermatis Fluidum.—Fluid extract of aspidosperma. Dose, ♏ j to ♏ x or more.

The fluid extract is a more eligible preparation than the alkaloid aspidospermine, which represents in part only the powers of the drug.

COMPOSITION.—Quebracho seems peculiarly rich in alkaloids, but it is doubtful whether any one represents in its entirety the physiological powers of the bark itself. The most important are *aspidospermine*, discovered by Fraude in 1878, and *quebrachine*, separated by Hesse in the following year. Hesse describes several other active constituents or alkaloids, but the two just mentioned are the most important.

ADULTERATIONS. — Soon after the first specimens were sent to Europe, the sudden demand which sprang up induced sophistication, and quebracho-wood and quebracho colorado were substituted for the genuine. This substitution proved the less important, since these preparations acted in a similar manner, and were only weaker (Penzoldt). The early physiological investigations must, therefore, be interpreted by the light of this difference in the action of the several substances comprehended in the term *quebracho.*

Physiological Actions.—Quebracho has the stomachal effects of the bitters in general: it promotes appetite and increases the digestive powers. The alkaloids diffuse promptly into the blood. The action of the heart is lowered; the pulse in the normal state is less frequent; at first, the tone of the artery is higher and the blood-pressure is raised, but as the action is continued, especially from lethal doses in animals, the force of the circulation declines and the pressure falls. The respiration is also slowed, and the sense of need of air is less imperative. The hurry of circulation and of respiration, and the feeling of oppression induced by active exercise, are modified by quebracho. Picot-Berthold studied these actions on his own person. Ascertaining first the rate of increase of the respiratory movements and of the circulation induced by active exercise of a definite amount, he next determined the influence of the remedy on these functions when the same amount of exercise had been taken. While without quebracho his pulse and respiration rose respectively to 42 and 94, under the action of the medicament they were 30 and 80. Not only was the rate of movement lessened, but the accompanying distress for want of air was decidedly ameliorated.

Guttmann, who has made an elaborate study of aspidospermine, finds that in both cold- and warm-blooded animals it is an active poison of the respiratory and circulatory apparatus. In cold-blooded animals the respiratory actions are most pronounced, and death is produced by the effect of the poison on the respiratory center. Slowing of the heart's action proceeds *pari passu* with the diminution of the respiratory energy, and the cessation of the heart's movements is finally due to the impression of the poison on the intra-cardiac motor ganglia. In warm-blooded animals (cats) the influence of the poison on the heart is primary. The slowing of the pulse is not due to any effect which it has on the vagi, but to the paralyzing action which it exerts on the cardiac motor ganglia. With the slowing of the heart the temperature declines, and, with the diminution of respiration, dyspnœa comes on. Then the accumulation of carbonic acid in the blood induces stupor, and in animals convulsions. The reflex function is lowered in cold- but not in warm-blooded animals; sensibility is unaffected in the latter, but motor paralysis finally occurs in both classes. Death is due to paralysis of the heart.

Therapy.—The applications of quebracho in the treatment of disease were originally empirical, but they are clearly deducible from its physiological actions. It has long been known as a fever-medicine and as a remedy for dyspnœa, in the province of Santiago, Chili, where it was first obtained by Dr. Schickendanz. It has been used as a stomachic tonic, like the bitters in general, but more especially like cinchona, to increase the appetite and digestion in *atonic dyspepsia*. It is, however, chiefly important as a remedy for *dyspnœa*.

Picot, Skoda, Krauth, Penzoldt, and many others, have used it in various instances of difficult breathing, with remarkable palliation. In *emphysema*, *spasmodic asthma*, *uræmic asthma*, in *spasmodic cough*, *chronic bronchitis*, with asthmatic breathing, it has afforded very considerable relief. It has appeared to be much less useful, if not injurious, in the dyspnœa from valvular disease of the heart, and has had no effect in the dyspnœa of old subjects due to atheroma of the vessels. Krauth, however, has used it with advantage in the dyspnœa due to hypertrophy of the heart and in the difficulty of breathing in a case of albuminuria consecutive to scarlatina. The relief to dyspnœa in all cases, Penzoldt thinks, is referable to the increased consumption of oxygen by the blood, but a more rational explanation would seem to be the action on the respiratory center, and the diminution in the sense of need of air.

Oxycamphor.—An artificial product of camphor-ortho-quinon, in which one molecule of hydroxyl (HO) replaces one molecule of hydrogen (H) in the formula for camphor. It is a white crystalline powder, soluble in 10 per cent of cold water. It has a somewhat pungent and bitter taste. It precipitates myosin but not albumin from their solutions, respectively. It is inhibitory of the lower forms of organic life, stops fermentation, and converts hæmoglobin into methæmoglobin, by preventing the absorption of oxygen. It paralyzes the nerve endings in the muscular layer of the vessels. Oxycamphor acts on the heart in a different manner from camphor—for while camphor stimulates the cardiac action in cold-blooded animals, oxycamphor retards and arrests. The differences are even greater in warm-blooded animals, camphor causing excitement and increased rate of breathing. Oxycamphor acts on the respiratory center, but not on the vaso-motor, except secondarily. In the treatment of dyspnœa the physiological actions furnish the indications for its administration. It should be very useful in cases of asthma, in the asthmatic paroxysms of emphysema. It will probably give relief to the excited breathing of phthisis and to the harassing cough.

Yohimbin or **Yumbehoa.**—A member of the *Apocynea*, growing in equatorial Africa.

Composition.—An alkaloid has been obtained from the bark, by L. Spiegel, who gave it the name *yohimbin*. It is a crystallizable principle having the formula $C_{23},H_{49}N_2O_4$. It combines with acids to form salts, of which the most eligible is the hydrochlorate.

The dose of the hydrochlorate of yohimbin is $\frac{1}{20}$ to $\frac{1}{10}$ gr. This salt may be dispensed in solution. Of a one-per-cent solution the dose should be from one to ten minims.

Physiological Actions.—The first study of the actions of yohimbin were made by Oberworth on both cold- and warm-blooded animals. It is a paralyzer of both classes of animals, inhibiting the central nervous system, leaving unimpaired the peripheral nerves and muscles. Electrical, chemical, and mechanical irritation of a motor nerve is followed by active contraction of the muscles to which it is distributed.

Yohimbin inhibits the heart's action finally in cold-blooded animals, stopping it in the diastole. The previous administration of atropine does not prevent this result. It is also a paralyzer of respiration, which becomes irregular in time and volume with the progress of the influence, and if artificial respiration is resorted to, death ensues by failure of the heart.

The blood-pressure falls as soon as the remedy is administered. This is due not to paresis of the muscular walls of the vessels, but to failure of the heart itself. The heart-beats are not increased by section of the vagi nor by the administration of atropine, nor does irritation of the vagus center or the peripheral vagus have any influence on the result. The actions of yohimbin on the circulation are therefore through the sympathetic or the motor ganglia of the heart, or both.

The most important effect is on the genito-urinary apparatus, causing active erections of the penis, emissions, and a general hyperæmia. No structural alterations take place in the kidneys and genitalia, notwithstanding the considerable hyperæmia and excitement which are produced by it in the whole apparatus.

Therapy.—The applications of yohimbin to treatment have been thus far limited to a few maladies. In sexual neurasthenia, in impotence due to functional depression of the sexual apparatus, its use is warranted by the results of the observations on animals. As it has a marked and distinctive action on the genito-urinary apparatus, it should prove useful in the chronic forms of albuminuria. It is contraindicated in acute affections of the kidneys, but in chronic Bright's disease and in such cases of albuminuria as are symptomatic of lowered vital action or depressed function, good results may be expected. This opinion is based on personal observation of appropriate cases, especially of chronic albuminuria, in which it has seemed to lessen the quantity of albumin present and to improve the general state.

REMEDIES USED TO MODIFY THE FUNCTIONS OF ORGANS (*CONTINUED*).

B.—OF THE GASTRO-INTESTINAL CANAL.

EMETICS.

SOME of the agents in this group produce vomiting by virtue of a local action on the stomach, and do not affect this viscus when introduced elsewhere. These may be entitled Emetics by Local Action. There are others which cause emesis when they enter the blood at any point—Systemic Emetics. The first sub-group of emetics make an impression on the gastric nerves, and an action is at once instituted for their expulsion. The process consists in the transmission of the peripheral irritation to the spinal center, the generation of a motor impulse, and the consequent action of the nervous and muscular apparatus concerned in the mechanism of vomiting. The systemic emetics produce their effects through the intermediation of the blood, and the vomiting is only one of the results of the disturbance introduced into the functions of the nervous system.

EMETICS BY LOCAL ACTION.

The most important of these are :
Cupri sulphas, sulphate of copper.
Zinci sulphas, sulphate of zinc.
Hydrargyri sulphas flava, yellow subsulphate of mercury.
Alumen, alum.
Sinapis, mustard.
Scilla, squill.

All of the members of this group have been discussed in other parts of this work, except mustard and squill, and the consideration of these will be more appropriate elsewhere. It is necessary, however, in this place to indicate the nature of the action, the cases to which they are adapted, and the mode of administration of the more important of the emetics belonging to this division.

Cupri Sulphas.—This is a very prompt and efficient emetic. The action begins in a few minutes, and the medicine comes up with the vomited matters. Very little depression follows the emetic action. It is more especially adapted to the treatment of *narcotic poisoning*, because, the action being local, the obtunded state of the reflex centers interferes less with its operation than is the case with the systemic emetics ; and to *phosphorus poisoning*, because of its antidotal power. It is also occasionally used in *croup*, to effect the dislodgment of the false membrane, but other mechanical emetics are preferable.

ADMINISTRATION.—Dissolve twenty grains of the sulphate of copper in two ounces of distilled water, and give a tablespoonful every fifteen minutes until vomiting occurs. When prompt action is required, as in narcotic poisoning, ten grains of the sulphate of copper may be given at a draught in an ounce or two of water. Its action should be assisted by the free use of diluents.

Zinci Sulphas.—This agent acts in a manner similar to the corresponding copper-salt, but is less powerful. It has the advantage of being less likely to induce gastro-enteritis than sulphate of copper, and is, therefore, usually preferred to the latter. It is administered in cases of *narcotic poisoning*, in *croup*, and to relieve the stomach of *indigestible alimentary substances*.

ADMINISTRATION.—In narcotic poisoning a scruple of the sulphate of zinc may be administered in water, and, if need be, repeated once. In croup, or for other purposes, as an emetic, it may be given as follows: Dissolve a half-drachm in two ounces of water, and administer a tablespoonful every fifteen minutes until emesis is produced. The free use of diluents promotes the emetic action.

Hydrargyri Sulphas Flava.—This is one of the most efficient members of this group. It is an active poison, but, as it is returned with the contents of the stomach, no danger attends its administration. It does not act so speedily as copper and zinc. It produces very little nausea, but, when the action begins, the effects are suddenly experienced, and are powerful, without leaving after-depression and sickness. It is not so well adapted to the treatment of narcotic poisoning as the copper and zinc sulphates, but it is the most desirable emetic in the treatment of *croup*. It was formerly much prescribed in this disease as an emetic, but it fell out of fashion until revived recently by Dr. Fordyce Barker. The author's experience in its use is, in the main, in accord with the much more extended experience of Dr. Barker.

ADMINISTRATION.—As the yellow subsulphate of mercury has but little taste, it is easily administered to children. It should be prescribed in the form of powder, rubbed up with sugar of milk. The dose varies from two to five grains. Dr. Barker makes the useful suggestion that powders of this preparation, labeled "croup-powders," should be kept in every household, the children of which have a tendency to attacks of croup. It should be given when the first symptoms manifest themselves, and its repetition will be governed by the state of the breathing.

Alumen.—Powdered alum is a safe, efficient, but slow emetic. About a half-hour usually elapses after it is swallowed before the emesis occurs. It acts mechanically, produces no considerable nausea, and leaves behind no depression. As an emetic, its only use is in *croup* and *diphtheria*, administered with the view to cause a detachment of the false membrane. Some effect has been ascribed to the local action of the alum in its passage along the throat, but this opinion is scarcely tenable.

Administration.—A teaspoonful of powdered alum may be administered in sirup, honey, or mucilage. It can be repeated, if need be, every half-hour.

Sinapis.—Mustard is a stimulant, local emetic. It acts promptly and efficiently. In emergencies, other emetics not being available, it may be employed in *narcotic and other forms of poisoning*. As an emetic it is especially adapted to depressed conditions of the system—for, while it causes vomiting, it stimulates the action of the heart. When, therefore, an emetic is indicated, and at the same time the circulation is feeble, the surface cold, and the functions of animal life oppressed, mustard should be used.

Administration.—A tea- to a dessert-spoonful of powdered mustard should be stirred up in a tumblerful of tepid water, and quickly swallowed. The irritant action of the mustard may be limited, and its emetic action promoted, by the free use of diluents.

SYSTEMIC EMETICS.

Apomorphine.—*Apomorphinæ Hydrochloras.*—Apomorphine hydrochlorate. The hydrochlorate of an artificial alkaloid obtained by the action of strong acids upon morphine contained in closed tubes and subjected to a somewhat elevated temperature. It is obtained also by the action of chloride of zinc in solution on morphine. It is a whitish powder, which becomes greenish by absorption of moisture. It is soluble in water, and it may, therefore, be administered in this menstruum. Dose, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$. If given hypodermatically, gr. $\frac{1}{16}$ is sufficient; if by the stomach, gr. $\frac{1}{8}$. As it undergoes important changes when in contact with water, the solution for hypodermatic use should be made when required, or at least should be frequently renewed.

Apocodeine.—*Apocodeinæ Hydrochloras.*—Apocodeine hydrochlorate. An artificial alkaloid obtained from codeine, as apomorphine is made from morphine. It has similar powers and properties to apomorphine, but it is somewhat less active as an emetic, while it is more useful as an expectorant. Apocodeine is given by the stomach or subcutaneously. The dose is gr. $\frac{1}{12}$ to gr. $\frac{1}{6}$.

Physiological Actions.—Whether injected under the skin or taken into the stomach, apomorphine causes vomiting. The rate at which it moves to affect the stomach depends somewhat on the dose administered. From five to twenty minutes elapse after the hypodermatic injection before vomiting begins. The act of vomiting is preceded by very little nausea, the contents of the stomach are usually thoroughly evacuated, and the vomiting recurs a few times at intervals of a quarter to a half hour. In young subjects very considerable depression has been observed to be produced by it, and dangerous symptoms of cardiac paralysis have followed its emetic action in a few instances. These clinical facts seem to contradict the experimental observations of Siebert and Moerz, who have shown that apomorphine does not affect the blood-pressure, and that the pulse rises when emesis comes on, reaches its maximum during vomiting, and declines in the interval. The cardiac depression which has been observed, clinically, may have been the result of idiosyncrasy, yet we should not lose sight of the fact observed by Harnack, that in cold-blooded animals it may be produced experimentally.

Apomorphine causes at first increased rapidity of the respiration, afterward diminishes the force and depth of the movements, and finally arrests them. As this result occurs when the vagi are divided, the drug must necessarily first excite and afterward exhaust the irritability of the respiratory center. Apomorphine has no appreciable influence on the temperature.

As respects its impression on the nervous system, apomorphine is at first strongly excitant. Afterward it causes muscular tremblings, followed by paralysis and convulsions. The muscular irritability is impaired but not destroyed, and the functions of motor and sensory nerves remain intact; hence it may be concluded that the convulsant action of this agent is due to a direct impression on the spinal cord (the spasm-center).

THERAPY.—Apomorphine is indicated as an emetic when swallowing is difficult or impossible, and when very prompt action is necessary. As it produces vomiting by its spinal action, profound narcosis will prevent it, and hence, in *narcotic poisoning*, it may fail of effect unless administered before narcosis has supervened. It is a suitable emetic when it is desired to empty promptly an *overloaded stomach*. It is to be preferred to all emetics which must be introduced into the stomach, when this viscus is in a state of inflammation, for it is best given subcutaneously. Apomorphine has been administered as an emetic in *suffocative catarrh*, to empty mechanically the bronchial tubes, but it produced serious depression—a result which might have been *a priori* predicted, since this drug exerts a paralyzing action on the respiratory organs. It has also been given as an *expectorant*, but on insufficient data, for it does not seem to have an effect upon the vagi, and, as above stated, at first it excites the respiration movements, and afterward paralyzes them.

As compared with its congeners, morphine and codeine, it is more excitant than morphine and codeine, and without their hypnotic and anodyne properties. As respects its convulsant action in animals, it has close physiological relations to narcotine and thebaine. Some clinical experiences have shown (Riegel und Böhm) that apomorphine causes heaviness in the head, giddiness, drowsiness, yawning, mental hebetude, etc. The trials in which these results were noted were made with Merck's preparation of apomorphine.

Recent experiences have demonstrated that apomorphine has remarkable calmative and hypnotic effects in the excitement and wakefulness of alcoholism. For this purpose it is better given hypodermically, although good effects have been obtained by the stomachal administration. The dose by the former method is from $\frac{1}{12}$ to $\frac{1}{4}$ gr., and by the latter, $\frac{1}{4}$ to $\frac{1}{2}$ gr.

It has proved most successful in delirium tremens, inducing quiet and refreshing sleep, when the most noisy and threatening delirium had occurred. This agent is probably one of those most relied on to remove the desire for alcoholic drinks, and to quiet the restlessness and excitement which the absence of the stimulant sets up in those undergoing the so-called cure.

Ipecacuanha.—*Ipecacuanha.* The root of *Cephaëlis ipecacuanha* A. Richard (Nat. Ord. *Rubiaceæ*). (U. S. P.) *Racine d'ipécacuanha,* Fr.; *Brechwurzel,* Ger.

Extractum Ipecacuanhæ Fluidum.—Fluid extract of ipecacuanha. Dose, ♏ ij—ʒ j.

Syrupus Ipecacuanhæ.—Sirup of ipecacuanha (fluid extract, 70 c. c.; sirup to 1,000 c. c.). Dose, ʒ j—℥ ss.

Tinctura Ipecacuanhæ et Opii.—(Deodorized tincture of opium and fluid extract of ipecac.) Dose, ♏ v—♏ xv. A liquid equivalent of Dover's powder.

Trochisci Ipecacuanhæ.—Troches of ipecacuanha (ipecac, tragacanth, arrow-root, sugar, and sirup of orange-peel). Dose, one or more. Each troche contains one fourth of a grain of ipecacuanha.

Trochisci Morphinæ et Ipecacuanhæ.—Troches of morphine and ipecacuanha (each troche contains one fortieth of a grain of morphine and one twelfth of a grain of ipecac).

Vinum Ipecacuanhæ.—Wine of ipecacuanha (fluid extract of ipecac, 100 c. c.; alcohol, 100 c. c.; white wine to 1,000 c. c.). Dose, ♏ j—ʒ j.

Pulvis Ipecacuanhæ et Opii.—Compound powder of ipecacuanha. Dover's powder. Ten grains contain one grain each of ipecac and opium, and eight grains of sugar of milk. This preparation has already been discussed in the article on opium.

COMPOSITION.—Since the time of Magendie *emetine* combined with *ipecacuanhic acid* has been held to be the active principle. The diverse opinions entertained regarding the physiological properties of this alkaloid have been explained by the discovery recently, by Paul and Cownley, that emetine is composed of two distinct alkaloids, which they have named *cephæline* and *emetine*, the latter being the same as the emetine described by Glenard. Ipecacuanhic acid is a glucoside, and is chemically related to kinic and caffetannic acids.

Antagonists and Incompatibles.—The salts of lead and mercury, the vegetable acids, and astringent infusions, are incompatible. The tannate of emetine is extremely insoluble. Bismuth, carbolic acid, hydrocyanic acid, and narcotics generally, hinder its emetic action.

Synergists.—The emetics—those by local action and the systemic—favor the vomitive action of ipecac. Its effects on the skin and bronchial mucous membrane are promoted by opium, warm diluents, etc.

Physiological Actions.—Inunctions of ipecacuanha excite very considerable irritation of the skin : at first, small, isolated pustules appear, and these are followed by large pustules and ulceration (Duckworth). When applied to the mucous membrane of the nares, it produces a sensation of heat, and causes sneezing. Some persons are so susceptible to its action that the smallest quantity inhaled will induce an asthmatic paroxysm.

Administered by the stomach in small doses (from one eighth to one quarter of a grain), ipecacuanha acts as a stomachic tonic, and probably increases the gastric secretions. In larger doses (from five grains to a scruple), it is nauseant and emetic ; but the sickness which it causes is not severe, and the vomiting is not accompanied nor followed by much depression. Its action as an emetic is rather slow, from twenty minutes to a half-hour being required, and is not persistent. Repetition of large doses will, in most cases, but not invariably, produce a condition of *tolerance*, when vomiting does not occur, but a cathartic action is induced, the stools having a peculiar bilious character, appropriately designated "ipecacuanha-stools." Both vomiting and purging are sometimes produced by an emetic of ipecacuanha.

Like other nauseants and emetics, ipecac increases the secretions of the broncho-pulmonary mucous membrane, and is, therefore, held to possess *expectorant* properties. More than any other agent of the class, it relaxes the skin, and promotes cutaneous transpiration.

Ipecacuanha exerts but little influence over the circulation. In animals, lethal doses of emetine cause death by paralysis of the muscles of respiration, the heart continuing in action after the cessation of the respiratory movements (D'Ornellas). The temperature of the surface falls, but the internal temperature remains the same, or rises somewhat, owing, it is said (D'Ornellas), to the irritant action of the agent on the intestinal mucous membrane.

In the *post-mortem* examination of animals killed by emetine, very considerable gastro-intestinal irritation is found. The lungs are sometimes seen to be hyperæmic and presenting patches of hepatization, and sometimes exsanguine, but the former condition is more frequently observed. As the most common state of the lungs, caused by lethal doses of ipecac, is similar to that which is induced by section of the vagi, it is a reasonable conjecture that it has a special action on these nerves—according to Chouppe, on the terminal filaments of the vagi.

The elimination of emetine takes place in large part by the gastro-intestinal mucous membrane, and it is found in the secretions.

The physiological actions of the alkaloids of ipecacuanha have been reported on by Wild, and his conclusions are represented in the following summary: Both cephæline and emetine possess a powerful emetic action, but the dose required to produce emesis was twice greater for emetine, but the nausea preceding vomiting was twice greater with cephæline. Both lower the arterial tension, but more depression was caused by emetine. Both cause contraction of the blood-vessels, but emetine is the more active. Both cause slowing and weakening of the heart's action in about the same degree. Both act as muscle poisons, but cephæline has the greater effect, and also acts on the motor nerve endings, causing muscular contraction. Salivation was caused by both, and a flow of nasal mucus by emetine. Both apparently increased peristalsis, and gave rise to loose motions without any distinct purgative action. No effect was observed on the skin or kidneys by either alkaloid.

Wild concludes that cephæline may prove useful as an emetic, without depressing effects, in doses of from one twelfth to one sixth of a grain. It is too slow in action, however, for cases of poisoning. As an expectorant in catarrhal and febrile conditions, emetine would seem to be indicated in doses of from one sixth to one third of a grain. The effect it has in causing contraction of the vessel explains the utility of ipecacuanha in hæmorrhage, and indicates the special value of emetine for this purpose.

THERAPY.—As both the alkaloids of ipecacuanha have a decided emetic property, they may be utilized under the same conditions and with the same limitations as the powder of the root. As they can be used subcutaneously, they present obvious advantages in many stomachal and other diseases. Although emetine is slower in action, it causes less nausea and systemic disturbance than cephæline. As these alkaloids increase secretion, nasal and intestinal, and also promote peristalsis, they can be prescribed instead of ipecacuanha in *torpor of the liver*, *constipation* from insufficient secretion of the intestinal glands, etc. Just as ipecacuanha is now prescribed as an expectorant in cases of *broncho-pulmonary catarrh*, ordinary *coughs*, *asthma*, and similar affections, emetine may now be substituted. As a remedy in *pulmonary hæmorrhage*, in *menorrhagia*, *purpura*, and similar morbid states, emetine will no doubt prove efficient. It is probable that in *uterine hæmorrhage*, under the conditions named in the paragraph on that subject, emetine subcutaneously may prove an efficient substitute for the crude drug. Until, however, more facts are accumulated and the true powers of the alkaloids are determined by clinical trials, it is probable that the crude drug, or its preparations, will continue to be preferred. For therapeutic purposes, the most efficient preparation is the fluid extract. The dose of this is so small and its efficiency so decided, that on the score of convenience as well as power it has many advantages as compared with the powder.

For ordinary purposes no emetic is more safe and efficient than ipecacuanha. As it causes but little depression, and is free from irritant effects in ordinary doses, it may be given in conditions of the system in which tartar-emetic and the other mineral emetics are inadmissible. When the stomach is to be relieved of *undigested aliment*, ipecacuanha is the most suitable emetic. Attacks of *acute indigestion*, *migraine*, and the so-called *bilious sick-headache*, may not unfrequently be cut short by an ipecac-vomit. The good effects of the vomitive treatment are not unfrequently most strikingly exhibited in the beginning of *continued fevers*, the *eruptive fevers*, *erysipelas*, and *periodical fevers*. It has been alleged that fevers are sometimes "aborted" in this way. In denying the possibility of such results, it must be admitted that clinical experience has shown the good effects of the practice on the subsequent course of the malady. Formerly an ipecacuanha-emetic was much more frequently employed at the outset of fevers than is the fashion at present, and the author is convinced that this mode of treatment should be resorted to now in suitable cases. The indications for the use of emetic doses of ipecacuanha, in the fevers above named, are these: a heavily coated tongue, much nausea and ineffectual efforts to vomit, a strong sense of epigastric oppression, icterus or an icterode hue of the surface, a hot and dry skin, acid and turbid urine. When these symptoms are present in cases of *malarial fever*, the antiperiodic remedies will be much more effective in their action if their administration has been preceded by an ipecacuanha-emetic.

In all the cases in which emetics are employed for mechanical effects, as in *membranous croup*, *capillary bronchitis*, *foreign bodies lodged*, etc., ipecacuanha may be used. In croup it is not so effective as the yellow subsulphate of mercury; in capillary bronchitis, as tartar-emetic; but, as respects the latter disease, ipecacuanha is to be preferred in the very young or very old, and in those debilitated by any cause. In the domestic treatment of *laryngismus stridulus* an emetic dose of the sirup of ipecac is the most usual remedy.

As an emetic, twenty grains of the powder of ipecacuanha may be diffused in a cup of warm water, and a tablespoonful of the mixture exhibited every fifteen minutes until emesis occurs. Two grains may cause vomiting; and four grains will usually act efficiently; hence a good method of proceeding, when an emetic effect is desired, is to exhibit a powder of four grains in a tablespoonful of warm water every fifteen minutes until vomiting occurs. The action will be facilitated by drinking freely of warm water; but, if the systemic impression of the ipecacuanha is desired, the patient should retain the recumbent posture, and all fluids should be withheld. If the cathartic as well as the emetic action is sought for, some weak animal broth should be given when the stomach is emptied of its contents. If free action of the skin is to be promoted, as soon as the vomiting has ceased, warm aromatic infusions should be administered, and the patient should be covered with blankets.

It has long been known that ipecacuanha, in small doses, has the power to arrest certain kinds of *vomiting*. Attention has recently been recalled to this curious fact. It is in *nervous vomiting* more especially that this remedy is useful: for example, in the *vomiting of pregnancy*, *vomiting of drunkards*, *vomiting of migraine*, etc. A minim of the vinum ipecacuanhæ, given every half-hour or hour in a little water, will sometimes relieve these cases in a very remarkable manner. It fails much more often than it succeeds, and the author has never yet seen an instance of its successful use in this way. The belief in this action is largely traditional—even apocryphal.

It is a singular fact, showing the remarkable phases through which professional opinion passes, that ipecacuanha, which was introduced at the close of the seventeenth century as a remedy for *dysentery*, after a time ceased to be employed in this disease, but has again been restored to the estimation in which it was originally held. *Epidemic dysentery*, especially of malarious and tropical countries, is the form of the disease to the cure of which ipecacuanha seems best adapted. The author has used it with much success in *acute dysentery*, as it occurs in the interior valley of this continent. When the characteristic ipecacuanha-stools are produced, the tormina and tenesmus cease, and the dejections soon become fecal; the skin, previously dry and hot, becomes moist and cool, and a refreshing calm is experienced. Large doses of ipecacuanha are required in the treatment of acute dysentery. In the severe attacks of tropical regions, from twenty to sixty grains are given for the initial dose, and the quantity subsequently administered depends on the effect —usually about twenty grains every four, six, or eight hours. It is important to establish *tolerance* of the remedy as speedily as possible. If the first dose be rejected, subsequent ones may be retained. Various expedients may be resorted to in order to secure the retention of these large doses. The ipecacuanha may be combined with some opium and aromatic powder: ℞ Ipecacuanhæ, ʒ ss; opium, gr. j; pulv. aromat., grs. v. M., ft. pulv. no. j. After the dose of ipecacuanha is administered, a sinapism may be applied to the epigastrium, and an enema of laudanum and starch, or the subcutaneous injection of morphine, may be practiced. Milk is an excellent vehicle for the administration of ipecacuanha. In the cases of dysentery treated on this plan by the author, he has found that doses of fifteen grains, given in milk, were generally pretty well borne. It not unfrequently happens, however, that tolerance can not be established, and the remedy must then be abandoned. Some patients so object to the nausea produced by it as to be reluctant to take it, and others, after one trial, decline to continue the treatment. Notwithstanding these drawbacks, it must be conceded that ipecacuanha is a most valuable remedy in epidemic and sporadic dysentery. It has been shown that in India, before the introduction of this method of treatment, the mortality from dysentery was about 79·6 per one thousand of cases; but, since the use of ipecacuanha has been generalized, the mortality has fallen to 20·15 per one thousand of cases.

Ipecacuanha has also been used with success in *chronic dysentery*, but, in the author's experience, it is by no means so beneficial as in the acute. It succeeds best in those cases which are the outgrowth of acute attacks, and in which the intestinal ulcerations are not far advanced. The rules for its administration are the same in chronic as in acute dysentery. In the *summer dysentery* and *diarrhœa of teething children* ipecacuanha is often extremely serviceable. The special indication for its use is the occurrence of greenish stools, containing mucus and sometimes blood. These stools are usually voided with much pain and straining. At the same time the skin is harsh and dry, the tongue rather dry and pasty, or glazed, and there is great thirst, although the fever may not be high. Ipecacuanha changes the character of the stools, induces perspiration, and allays the thirst and dryness of the mouth. From two to five grains every two hours may be given in these cases, or it may be administered with pepsin, oxide of zinc, bismuth, or other remedies. ℞ Ipecacuanhæ, grs. xij; bismuthi subcarb., ʒj; pepsinæ sacch., ʒss. M., ft., pulv. no. xij. Sig.: *One in milk every two hours.*

The evidence is conclusive that ipecacuanha possesses very valuable antihæmorrhagic powers. It has been successful in *hæmoptysis, epistaxis, menorrhagia, post-partum hæmorrhage*, etc. As Peter has observed, "the vomitive medication" (ipecacuanha) "arrests not only hæmoptysis but all kinds of hæmorrhage, and is, therefore, a general antihæmorrhagic medication." In hæmorrhages the ipecacuanha should be given in frequently-repeated doses until vomiting ensues; usually, when this effect is produced the hæmorrhage ceases. Other antihæmorrhagic agents may be combined with ipecacuanha. ℞ Ext. ipecac. fluidi, ʒij; ext. ergotæ fluidi, ʒiv; ext. digitalis fluidi, ʒij. M. Sig.: *Thirty minims to a teaspoonful at a dose, as required.* The author has witnessed excellent results from this combination in hæmoptysis and menorrhagia. In the treatment of *post-partum* hæmorrhage, the most suitable combination is fluid extract of ipecacuanha and fluid extract of ergot. Trousseau strongly urges the employment of ipecacuanha in *post-partum* hæmorrhage, and, indeed, in the various accidents which occur in the *puerperal state*, and, above all others, as respects the utility of the treatment—puerperal dysentery—in which the author has verified Trousseau's statements. "He has not observed the least ill-result from this practice; on the contrary, in the most of these cases, he has obtained either a cure or a notable amendment."

Certain acute affections of the broncho-pulmonary mucous membrane are much benefited by non-emetic doses of ipecacuanha; for example, *acute catarrh of the nasal and bronchial mucous membrane, hay-asthma, capillary bronchitis.* An emetic dose will cut short an attack *of laryngismus stridulus.* An occasional emetic gives great relief in *whooping-cough*, when there is profuse bronchial secretion. Non-emetic doses of the fluid extract (♏ j—♏ iij) diminish the violence of the spasms in this disease. Nauseating and emetic doses are serviceable in the attacks of *spasmodic asthma*, but the good effects of the remedy are lost by repetition. Ordinary *colds*, especially in children, are benefited by doses sufficient to produce slight nausea but not vomiting. A troublesome cough at night, which prevents sleep, may not unfrequently be arrested by a dose at bed-hour of some one of the ipecacuanha preparations. For these various purposes the wine or the fluid extract may be used, but the latter preparation is much more trustworthy and effective than the former, if genuine.

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Antimonii et Potassii Tartras.—*Antimonium and Potassium Tartrate.*—Tartar-emetic.

This is a powerfully spoliative and depressing emetic, which has already been discussed under the head of "Agents promoting Destructive Metamorphosis." It was formerly much employed as an emetic in croup, capillary bronchitis, and at the onset of fevers and inflammations; but the local irritation, as well as the systemic depression which follows, has led to its almost entire disuse for these purposes; but, in the author's judgment, not wisely *in toto.*

ADMINISTRATION.—Six grains may be dissolved in four ounces of water, and a tablespoonful be given every fifteen minutes until emesis occurs. Ipecacuanha and tartar-emetic are frequently administered together—twenty grains of the former and two grains of the latter.

CATHARTICS.

Purgatives are divisible into several groups, according to the nature of their action.

Laxatives are medicines which stimulate the intestinal movements, without increasing to any considerable extent, at least, the intestinal secretions.

Saline Purgatives excite increased secretion, while at the same time they hasten the peristaltic action. The dejections which are produced by them are loose and watery.

Mercurial Purgatives, chiefly calomel and blue mass, exert an influence peculiar to themselves. Without expressing an opinion at present, for or against their supposed cholagogue effects, the author believes that they differ so much in their action from other purgatives as to be appropriately placed in a separate class.

Tonic-astringent and Resin-bearing Purgatives.—These affect the liver and the glandular appendages of the mucous membrane, and increase the tonicity of the muscular layer of the intestine. They increase the proper secretion of the glands, and do not merely cause an outward diffusion from the vessels into the canal.

Hydragogue Purgatives act with great energy, and not only increase the glandular secretions, but cause a very abundant outward diffusion, so that the dejections which they produce are extremely watery. This group of purgatives also excite very rapid and violent peristaltic movements.

Laxatives.—Manna.—*Manna.* The concrete, saccharine exudation, in flakes, of *Fraxinus ornus* Linné (Nat. Ord. *Oleaceæ*). Dose, ʒ j—℥ ij, according to age.

Composition and Properties.—Manna has a sweetish, rather mawkish taste; is soluble, when pure, in three parts of cold water, and in its own weight of boiling water. It contains a sugar—*manna-sugar* or *mannite*, which constitutes from seventy to eighty per cent of the best specimens of manna. It is said to contain dextrin, or a mucilage having similar reactions, and ether extracts from it in small quantity a slightly acrid, reddish-brown resin, on which the laxative property of manna probably depends.

Actions and Uses.—Manna is a very mild laxative, but, when administered alone, is apt to cause griping. It is rather slow in its operation, but is free from irritating qualities, and leaves no unpleasant after-effects. It is most frequently combined with other purgatives—senna chiefly—the operation of which it aids, and at the same time renders less drastic. It is rarely given alone, and only to children and pregnant women. Formerly it was used as a laxative in hæmorrhoidal affections.

Sulphur.—*Sulphur lotum* (washed sulphur). *Sulphur sublimatum* (sublimed sulphur). Washed sulphur only should be used as a laxative. Sublimed sulphur contains a trace of acid which imparts to it a griping quality. Dose, ʒ j—ʒ iij.

ACTIONS AND USES.—Sulphur is insoluble in water, but dissolves in alkaline solutions and in the volatile and fixed oils. In the small intestine, sulphur is placed under favorable conditions for absorption. That it does enter the blood is proved by the fact that it appears in the perspiration, urine, milk, etc. Silver coins, carried in the pockets of those taking sulphur, are discolored by the formation of the sulphide of silver. Considerable sulphureted-hydrogen gas is produced as a result of the chemical changes in the intestines, and a quantity of offensive flatus is an unpleasant sequel of its administration. The intestinal secretions are somewhat increased by it, and the stools are therefore softer. It is a very mild laxative. Combination of sulphur and bitartrate of potassa or magnesia is occasionally resorted to, especially in domestic practice, for the purpose of increasing the laxative action.

Sufficient attention has already been paid to the sulphur compounds, and it only now remains to speak of sulphur as a laxative. It is used chiefly to render the stools softer and more easily voided in cases of *hæmorrhoids*, *fissures of the anus*, and after *surgical operations about the pelvic organs.* It is used also as a laxative in *skin-diseases*, *chronic rheumatism*, *sciatica*, and *lead-cachexia*, conjoined usually with sulphur-baths, the sulphurous mineral waters, and other appropriate medication.

PULVIS GLYCYRRHIZÆ COMPOSITUS is an efficient laxative. It is made as follows: Senna-leaves, eighteen parts; licorice-root, sixteen parts; fennel-seeds, eight parts; washed sulphur, eight parts; refined sugar, fifty parts. M. Sig.: A teaspoonful at a dose.

Magnesia.—*Magnesia.*—Light magnesia. A white, very light and very fine powder, slowly absorbing carbonic acid from the air, odorless, having an earthy but no saline taste, and a faintly alkaline reaction when moistened with water. It is almost insoluble in water, or in alcohol, etc. Dose, ʒ ss—ʒ ij, or more.

Magnesia Ponderosa.—Heavy magnesia. A white, dense, and very fine powder, corresponding in all other properties to the above. Dose, ʒ ss—ʒ ij.

Magnesii Carbonas.—Magnesium carbonate. Light, white, friable masses, or a light, white powder, odorless and tasteless, insoluble in alcohol, and almost insoluble in water. Dose, ʒ ss—ʒ ij.

Mistura Magnesiæ et Asafœtidæ.—Mixture of magnesia and asafœtida. (Carbonate of magnesium, five parts; tincture of asafœtida, seven parts; tincture of opium, one part; sugar, ten parts; and sufficient distilled water to make up one hundred parts. Dewees's formula.) Dose, one fourth to one teaspoonful.

Actions and Uses.—A mild antacid laxative. In the stomach it neutralizes any free acid it meets with, and the resulting salt has a laxative action. It is used to correct *acidity*, the carbonate being preferred when there is an irritable state of the stomach, because the carbonic acid, which is set free by the action of the stomach acid, is a local sedative and anodyne. If magnesia does not enter into combination with the stomach acid, no laxative effect is produced. Under these circumstances a solution of citric acid or lemonade, taken after the magnesia, will cause it to act. Magnesia is a useful antacid and laxative in *sick-headache*, especially when accompanied by acidity and constipation. It has been employed also in *gouty affections*, and in *lithiasis* (uric acid); but it is much inferior to the potash salts in these affections. In the intestinal indigestion of infants, attended with flatulence, magnesia is much prescribed in conjunction with carminatives. Dewees's formula for *flatulent colic* and *diarrhœa* in infants has been made official, and is given above as *Mistura Magnesiæ et Asafœtidæ.* The carminative of Dalby is similar in composition: ℞ Magnesii carbonat, ℈ij; ol. menth. pip., gt. j; ol. myrist., gtt. ij; ol. anisi, gtt. iij; tinct. castor., gtt. xxx; tinct. asafœtid., gtt. xv; tinct. ol. hedeomæ, gtt. xv; tinct. cardam. comp., gtt. xxx; aquæ menthæ pip., ℥ij. M. Sig.: *A teaspoonful, as necessary.*

Magnesia is frequently combined with other purgatives because of its antacid property. The following is Meigs's formula, gelsemium having been substituted for henbane: ℞ Magnesii carb., ʒss; magnesii sulphat., ʒiij; spts. ammoniæ aromat., ʒj; tinct. rhei, ℥ss; tinct. gelsemii, ʒss; aquæ menthæ pip., ℥iv. M. Sig.: *A tablespoonful two or three times a day.*

It is unsafe to use magnesia in large quantity for lengthened periods, owing to the fact that it may form intestinal concretions—a hydrate of magnesia. Instances of this kind have been reported.

Freshly-precipitated hydrate of magnesia is an antidote to arsenious acid in solution, but it is not so effective as the hydrated sesquioxide of iron.

Fel Bovis.—*Ox-gall.*—The fresh bile of *Bos Taurus* Linné (class *Mammalia;* order, *Ruminantia*).

Description.—A brownish-green or dark-green, somewhat viscid liquid, having a peculiar odor, a disagreeable, bitter taste, and a neutral or faintly alkaline reaction.

Pig's-gall, which can be procured in any desired quantity, should be substituted for ox-gall, as it conforms more nearly to the characteristics of human bile.

Fel Bovis Purificatum.—*Purified Ox-gall.*—Fresh ox-gall precipitated by alcohol and evaporated to the proper consistence for a pill-mass. Dose, gr. x—ʒ j.

Actions and Uses.—The above-mentioned preparations of ox-gall have a liquefying effect on the bile; they increase the duodenal secretions, emulsionize fats, and quicken the peristalsis of the intestines. Hence, they are laxative. Ox-gall has been given with some success in those disorders of the intestinal canal characterized by the absence of some secretions, and the diminution of others, by foul odor of the stools due to decomposition, and in jaundice, when the bile is retained in the liver because of inspissated masses that block the common duct, or of mucus that has had the same effect.

Rhamnus Purshiana.—*Cascara Sagrada.*—The bark of *Rhamnus Purshiana* De Candollé (Nat. Ord. *Rhamnaceæ*).

Extractum Rhamni Purshianæ Fluidum.—Fluid extract of rhamnus Purshiana. Dose, ♏ x—ʒ ij.

Action and Uses.—Under the name cascara sagrada (sacred bark) it has long been used in California as a cathartic. Besides this action, extraordinary qualities have been attributed to it. The taste is bitter, and it has some of the properties of substances of that kind, having the effects of a stomachic tonic. It improves appetite and digestion, and increases the secretions of the gastro-intestinal canal, in consequence of which it has a laxative action. In this combination of tonic and cathartic effects, cascara resembles rhubarb (Tcheltzaffon). Although a cholagague action is ascribed to it, there is no reason to suppose that it possesses this property in any higher degree than rhubarb. It is well adapted for the relief of *catarrhal jaundice*, and it is useful in cases of *dyspepsia* accompanied by *constipation*. *Habitual constipation*, as a merely functional state, has been cured by it, and it is now much in request for the treatment of that condition. As a laxative, for the relief of hæmorrhoids and affections of the pelvic organs, it is quite useful.

Authorities referred to:

Eymery, Dr. *Thèse de Paris*, 1884. Quoted by *Journal de Thèrapeutique*, 1884.

Limousin, M. *Pharmacist. Bulletin Général de Thèrapeutique* for 1884.

Tcheltzaffon, Dr. Research in Professor Botkin's Laboratory. Quoted by *Virchow und Hirsch's Jahresbericht* for 1886.

Oleum Ricini.—*Castor-oil. Huile de ricin*, Fr.; *Castoröl*, Ger. A fixed oil expressed from the seed of *Ricinus communis* Linné (Nat. Ord. *Euphorbiaceæ*). Dose, ʒ j—℥ j.

Properties and Composition.—Castor-oil has a pale amber-color, a rather nauseous taste, and is quite viscid. Cold increases the viscidity. It has a specific gravity of about 0·96. It contains several fatty acids—*palmitic* and *ricinoleic*—the latter peculiar to castor-oil. The seeds appear to contain a drastic constituent, which is more powerfully purgative than the oil. The purer the oil, the less active its purgative property.

Actions and Uses.—Castor-oil is a mild but very certain and efficient laxative. It operates in from four to six hours, causing but little pain, and producing copious stools. It increases but slightly the intestinal secretions—hence the stools are not very liquid. Its purgative principle enters the blood, and the milk of the mother may in this way acquire a purgative property. It does not appear to have any effect upon the hepatic secretion. Röhrig's experiments, which demonstrated this point, have been confirmed by the subsequent investigations of Rutherford and Vignal. After the action of castor-oil has been completed, it may not unfrequently be seen floating on the stool; yet Buchheim (Husemann) has been unable, after careful examination of the fæces, to discover in them castor-oil or any of its derivatives.

Castor-oil is justly held in great esteem as a *laxative for children, for pregnant women, for the puerperal state.* When *hardened fæces* and *irritating substances* are to be removed from the intestinal canal, castor-oil is the most efficient purgative compatible with safety. When *inflamed hæmorrhoids, fissures of the anus*, or *surgical operations on the pelvic viscera*, require the use of a mild, certain, but unirritating laxative, castor-oil should be selected. Unfortunately, its taste is so repugnant to many palates, that no considerations will overcome the disgust which it excites. No remedy is more useful in the *diarrhœa of children*, induced and maintained by undigested aliment or irritating secretions. It is judicious practice, in these cases, to give a laxative dose of castor-oil to empty the canal, and follow it with an opiate or enema of laudanum. The *dysentery of children*, and *sporadic dysentery of adults*, especially after the more acute febrile symptoms have subsided, are generally very successfully managed by an emulsion of castor-oil: ℞ Ol. ricini, ℥ j; mucil. acaciæ, syrup. simplicis, āā ℥ ss; aquæ cinnamomi, ℥ ij. M. Sig.: *A tablespoonful every four to six hours.* In cases of dysentery, when there are much pain, tenesmus, and frequent passages, ten to twenty drops of laudanum may be added to each dose; when there are much depression, a low state of the arterial tension, and a dry, glazed tongue, five drops of turpentine may also be added.

A poultice made of the leaves of the castor-oil plant applied to the breasts, it is said, has the power to promote the secretion of milk. Warm applications to the mammæ undoubtedly stimulate their functional activity, but it is questionable whether castor-oil leaves have a special galactagogue property. It is said, however, that the inhabitants of the Cape Verd Islands have long been acquainted with this supposed property. The internal use of a fluid extract of the leaves has also, it is supposed, the power to determine an increased secretion of milk. Jaborandi will probably prove to be more effective in this respect than the ricinus communis.

Saline Purgatives.—Many of these have been discussed elsewhere; some of them are no longer employed in medical practice. The sulphate and the citrate of magnesium may be regarded as typical representatives of the class, and hence, in a statement of their physiological actions and therapeutical applications, may be comprehended all that is of immediate and practical value on the subject.

Magnesii Sulphas.—Magnesium sulphate. *Sulfate de magnésie*, Fr.; *Bittersalz*, Ger. In colorless crystals, which slowly effloresce on exposure to the air, and are very soluble in water. Dose, ʒ j—℥ j.

Magnesii Citras Effervescens.—A white, coarsely-granular salt, deliquescent on exposure to air, odorless, having a mildly acidulous, refreshing taste, and an acid reaction. Soluble with copious effervescence in two parts of water at 60° Fahr.; almost insoluble in alcohol. Dose, ʒ j—ʒ iv.

Liquor Magnesii Citratis.—Solution of citrate of magnesia. Dose, ℥ iv—℥ viij. A tablespoonful of the granular salt added to a half-tumblerful of water, and drunk during effervescence, is the quantity and the form in which it may also be taken. The bottled solution, which is also highly effervescent, must be drunk immediately on being poured out. It is a pleasant drink, and, when properly prepared, an active cathartic.

Physiological Actions of Saline Purgatives.—As a general rule, saline cathartics are easily borne by the stomach; especially is this true of the Epsom salts. The purgative action is due chiefly to increase of the intestinal secretions, and hence the stools are large and watery. Thiry and Radziejewski had apparently demonstrated that all purgatives acted by increasing the peristaltic movements, but exactly opposite results have been obtained by Moreau, whose observations have been confirmed by Vulpian and Brunton. The conclusion reached by the last-named observer is expressed as follows: "Such positive results as these seem to prove that purgatives do cause a flow from the intestinal wall, quite as conclusively as experiments with Thiry's fistula do the opposite; and, as the conditions under which the purgatives act on the intestines more nearly approach the normal in Moreau's than in Thiry's experiments, there can be little doubt that purgatives produce a decided secretion of fluid from the intestines, as well as accelerate peristaltic movements." Of the agents employed by Brunton in his experiments—croton-oil, elaterin, gamboge, jalapin, and sulphate of magnesia—the greatest secretion was caused by the latter. The results of the best directed experiments are, therefore, in accord with clinical observations, and it may hence be considered as established that saline cathartics produce an outpouring of fluid into the intestinal canal. This outward osmosis occurs chiefly from the vessels, and is not truly a secretion of the glandular appendages of the mucous membrane.

THERAPY.—The saline purgatives are indicated in *acute inflammatory affections*, as a part of the denutrition treatment. If the arterial tension is abnormally high, purgatives, especially the salines, lower it, as the sphygmographic tracings show. When a considerable quantity of serum is withdrawn from the intestinal vessels, the blood-pressure is necessarily diminished elsewhere (Brunton). Free transudation from the blood-vessels of the intestinal canal lessens the amount of work which the kidneys have to do, and, if these organs are hyperæmic, removes the congestion. Saline cathartics are therefore very important remedies in the treatment of *renal and cardiac dropsy*. Free purgation, also, influences the condition of the kidneys by reflex action. As a result of the lessened hyperæmia of the kidneys, the diminution of the blood-pressure, and the reflex stimulation of these organs, the action of a purgative is often followed by greatly-increased activity of the renal function. In *ascites* from obstruction of the portal circulation, saline cathartics are even more conspicuously beneficial than in general dropsy—for in this case they affect directly the organs involved. *Cholæmia, uræmia, œdema of the brain, increased intracranial blood-pressure* from any cause, are conditions requiring the use of active saline cathartics.

The most important applications of saline cathartics are in the treatment of various intestinal disorders. When the stomach is irritable, and the intestines inflamed, no other purgative is so well borne as Epsom salts, and its use may be resorted to when any other agent of the kind would be inadmissible. *Impaction of the cæcum*, and *typhlitis* resulting from this cause, may be removed by the proper administration of this remedy. It is unsafe, by active and drastic purgatives, to attempt to unload the bowel—for these harsh measures will only aggravate the existing inflammation. Epsom salts will liquefy the fecal masses and deplete the vessels, and thus remove the obstruction without causing any irritation. Small doses frequently repeated are more suitable than a large purgative dose. Usually about a teaspoonful in a wineglassful of water, every three hours, will be the quantity required. Perityphlitis and the peritonitis arising from inflammation and perforation of the *appendix vermiformis* are conditions in which purgatives of any kind are inadmissible.

The constipation which accompanies *lead-colic* can be overcome by Epsom salts. ℞ Magnesii sulphatis, ℥j; acidi sulphuric. dil., ʒj; aquæ, ℥iv. M. Sig.: *A tablespoonful every three hours.* As Brunton has pointed out, the administration of Epsom salts is a very important expedient in the treatment of the *saturnine cachexia.* Lead, as well as other minerals, mercury and copper, for example, is eliminated with the bile, and is discharged into the intestine, where it is again absorbed. For an indefinite period, therefore, the absorption and discharge of the same metal may be going on; and hence the utility of giving purgative doses of Epsom salts during the treatment of lead-poisoning.

The most efficient treatment of *acute dysentery* is by the administration of sulphate of magnesia. It is especially adapted to the acute stage when there are fever, pain, tenesmus, and stools of mucus and blood. It lessens the hyperæmia and causes fecal evacuations, with the result of relieving the pain and the distressing straining. It is administered as follows: Take a sufficient quantity of sulphate of magnesia to saturate eight ounces of water, and to this saturated solution add one half ounce of diluted sulphuric acid. The dose of this is a tablespoonful every hour or two, in a wineglassful of water, until it operates. Sulphate of morphine may be combined with it, or starch enemata with laudanum may be employed.

The *bleeding from hæmorrhoids* may sometimes be arrested by the above-described solution of Epsom salts and sulphuric acid, especially if the state of the hæmorrhoidal vessels be due to constipation. *Uterine hæmorrhage* caused by the presence of a fibroid, or by *subinvolution,* and *congestion of the pelvic viscera,* are not unfrequently relieved by the same agent when other agents apparently more powerful fail. When congestion of the pelvic organs, constipation, and anæmia coexist, the following is an efficient remedy: ℞ Magnesii sulphat., ℥ j; ferri sulphat., manganesii sulphat., āā ℈ j; acid. sulphur. dil., ʒ ij; aquæ, ℥ iv. M. Sig.: *A tablespoonful in a wineglassful of water each morning before breakfast.* For *habitual constipation* in those of full habit and active circulation, a daily morning dose of a teaspoonful of Epsom salts is often a permanently effective remedy.

The disagreeable taste of Epsom salts is perfectly well covered by coffee. Boil for two minutes in an earthen vessel one ounce of sulphate of magnesia and two and a half drachms of roasted coffee in a pint of water; then remove from the fire, allow it to "draw" for a few minutes, and strain.

The other saline purgatives belonging to this group are:

Sodii Sulphas, sulphate of sodium, Glauber's salts,

Potassii Sulphas, sulphate of potassium; but both of these have long since ceased to be used.

Sodii Phosphas, phosphate of soda,

Potassii et Sodii Tartras, tartrate of potassium and sodium, Rochelle salts, and

Pulvis Effervescens Compositus, effervescing aperient powders or Seidlitz powders, have been considered elsewhere.

Potassii Bitartras, bitartrate of potassium, cremor tartar, may also be regarded as a member of this group, although it has but feeble purgative property.

Mercurial Purgatives.—As the actions and uses of the mercurial preparations have been sufficiently discussed elsewhere, little need be said in addition as respects their applications as purgatives.

Hydrargyri Chloridum Mite.—Mild chloride of mercury. Calomel. Dose as a cathartic, gr. j—grs. x.

Massa Hydrargyri.—Mercurial pill. Blue mass. Dose, grs. v—grs. xv, as a cathartic.

ACTIONS AND USES.—These mercurial purgatives are rather slow in their action. A dose at bedtime will usually operate during the course of the following morning. One grain of calomel or five grains of mercurial pill will produce distinct purgative effects in most persons in about twelve hours, unless there be considerable habitual torpor of the bowels. They are apt to cause griping pains, nausea, and even vomiting, when the purgative effects begin. First brownish and bad-smelling, and afterward greenish stools, supposed formerly to be characteristic of the mercurial action, are produced. Much heated discussion has arisen as to the cholagogue action of mercury. Without entering into details on this point, it may be admitted that bile-elements are found in the stools from the action of mercury, as they are unquestionably found in the stools caused by some other purgatives. The presence of bile-elements in the fæces discharged, only proves that mercurial cathartics swept them out with the other contents of the intestinal canal, and does not prove that an excitant action was exerted on the secretory function of the liver. The stored-up bile in the gall-bladder may be emptied into the intestine in obedience to a reflex influence transmitted from the intestinal mucous membrane irritated by the purgative. Experimental investigations must be invoked to determine the question whether mercurials actually stimulate the liver to the production of an increased quantity of bile. In another place the experiments of Hughes Bennett's Edinburgh Committee have been stated. Since the report of that committee has made its appearance, the very accurate and painstaking investigations of Rutherford and Vignal have been published. Röhrig had already determined as the result of his experiments that "with large doses (twenty grains for a dog) it rarely happened that the secretion of bile was recalled after it had come to a standstill, although this agent can increase the secretion when it is only diminishing." Rutherford and Vignal arrived at the following conclusions as the results of their experiments with calomel: "1. An increase of the biliary secretion followed the administration of two successive doses of ten grains of calomel in one case (Experiments 30). Diminution of the secretion was the only result of the same doses given under similar circumstances in other two cases (Experiments 31 and 32); and it was the most definite result of the administration of four successive doses of three grains in another case (Experiment 33). 2. In all the four experiments the calomel had a purgative effect. 3. Analysis of the bile secreted during the calomel purgation in Experiment 33 showed that, notwithstanding a diminution in the quantity of bile secreted, the percentage amount of solids had become less." The results of experiment render it probable that mercurials do not increase the secretion of bile in animals, but we are not without confirmatory evidence in the human subject. In the cases of biliary fistulæ (accidental) observed by Westphalen and Ranke, no increase, but rather a diminution in the amount of bile, followed the exhibition of calomel in purgative doses.

That the purgative action of mercurials has a distinctive and peculiar quality, a vast clinical experience attests. The stools are rather different from those caused by other purgatives, and the therapeutical effects are, it is generally held, *sui generis*. Whatever peculiarity pertains to the purgative action of mercurials is probably due to the fact that they greatly increase the elimination of the products of waste, or retrograde metamorphosis of tissue, by the intestinal glandular apparatus.

As a purgative, the use of mercury is restricted to those cases in which a deficiency of bile is supposed to be the cause of the morbid state—*clay-colored stools, jaundice from catarrh of the gall-ducts*; and to those cases, singularly enough, in which bile is supposed to be in excess—*biliousness*, so called, jaundice from excessive production of bile, etc. For further remarks on the actions and uses of mercury the reader is referred to the section on remedies used to promote destructive metamorphosis.

TONIC-ASTRINGENT AND RESIN-BEARING PURGATIVES.

Senna.—Senna. The leaflets of *Cassia acutifolia* Delile (Alexandria senna), and of *Cassia elongata* Vahl (India senna), (Nat. Ord. *Leguminosæ, Cæsalpinaceæ*). (U. S. P.) *Feuilles de séné*, Fr.; *Sennesblätter*, Ger.

Confectio Sennæ.—Confection of senna. (Senna, coriander-seed, licorice, figs, prunes, tamarinds, cassia.) Dose, ʒ j—ʒ ij.

Extractum Sennæ Fluidum.—Fluid extract of senna. Dose, ℥ ss.

Infusum Sennæ Compositum.—Infusion of senna. (Senna, 60 grm.; manna, 120 grm.; magnesium sulphate, 120 grm.; fennel, 20 grm.; boiling water, 800 c. c.; cold water to make up to 1,000 c. c. Dose, ℥ iv.

Syrupus Sennæ.—Sirup of senna. Dose, ʒ ss—ʒ ij.

Composition.—The active constituents of senna prove to be a peculiar colloid body, and an acid, to which has been given the name *cathartic acid.* It has been shown that "*cathartate of ammonia* possesses, in a concentrated form, the purgative activity of the original drug." Two bitter principles have been obtained from senna—*sennacrol* and *sennapicrin.* It contains also a peculiar sugar—*cathartomannite.*

Actions and Uses.—The taste of senna is nauseous and bitter. In infusion—the form in which it is most usually prescribed—it is most disagreeable in odor as well as taste. It produces a sense of warmth in the stomach, and causes much flatulence and griping, which may, however, be prevented by combination with aromatics. Its active principles are absorbed, and the milk of the mother taking senna acquires a purgative property. It is a very efficient cathartic, producing copious liquid stools in about four hours. It does not cause inflammation or hypercatharsis, and its purgative action is not followed by intestinal torpor and constipation. It were, therefore, a very safe and serviceable cathartic, if it were not so disagreeable.

The confection of senna is a palatable preparation, and a mild laxative, operating without any disturbance. It is used chiefly to correct the *constipation of pregnancy*, but it is highly prized by some patients as a remedy for *habitual constipation.* It is also taken to procure soft and easy evacuations in *hæmorrhoids, fissures of the anus*, etc. A large bolus (one hundred and twenty grains), taken at bedtime, will operate gently on the following morning. The fluid extract of senna is a form for the administration of this drug more agreeable than the infusion. These two preparations are very excellent cathartics to overcome constipation; especially when ordinary purgatives fail.

The action of senna is much improved by combination with other purgatives, and with aromatics. The well-known "black draught" is an infusion of senna with sulphate of magnesia—one ounce of the latter dissolved in four ounces of the former. By the addition of coffee, the odor and flavor of senna may be rendered more tolerable. Two drachms of senna and one drachm of coffee may be infused in three ounces each of hot milk and boiling water, and the whole drunk after twelve hours.

Rheum.—Rhubarb. The root of *Rheum officinale* Baillon (Nat. Ord. *Polygonaceæ*). *Rhubarbe*, Fr.; *Rhabarber*, Ger.

Extractum Rhei.—Extract of rhubarb. Dose, gr. x—gr. xv.

Extractum Rhei Fluidum.—Fluid extract of rhubarb. Dose, ʒ ss —ʒ ij.

Pilulæ Rhei.—Rhubarb-pills. Each pill contains three grains of rhubarb and one grain of soap.

Pilulæ Rhei Compositæ.—Compound pills of rhubarb. (Rhubarb, purified aloes, myrrh.) Dose, 2—4 pills.

Syrupus Rhei.—Sirup of rhubarb. (Fluid extract, ℥ iij; simple sirup, ℥ xxix.) Dose, ʒ ss—ʒ ij.

Tinctura Rhei Aromatica.—Aromatic tincture of rhubarb. (Rhubarb, cloves, cinnamon, nutmeg.) Dose, ʒ ss—ʒ ij.

Tinctura Rhei.—Tincture of rhubarb. Dose, ʒ j—℥ ss.

Tinctura Rhei Dulcis.—Sweet tincture of rhubarb. Dose, ℥ ss—℥ ij.

Vinum Rhei.—Wine of rhubarb. (Rhubarb, calamus, stronger white wine.) Dose, ʒ j—℥ ss.

Pulvis Rhei Compositus.—Compound powder of rhubarb. Dose, a teaspoonful.

COMPOSITION.—Rhubarb contains a number of substances which have been isolated, but its composition has not yet been accurately determined. It contains two acids, *rheo-tannic* and *rheumic*, a resinous body, *phæoretin*, and *chrysophan*, or *chrysophanic acid.*

PHYSIOLOGICAL ACTIONS.—In small doses, rhubarb is a tonic astringent. It promotes the appetite and the digestive power, and, by virtue of its tannin, is astringent and diminishes peristalsis. As it contains also a purgative principle, in sufficient doses cathartic effects follow its administration. The stools are stained by the coloring-matters of the rhubarb, are of a yellowish-brown color, and are rather soft without being watery. After the purgative action has ended, the astringent constituents assert their power and constipation results. As the stools present an appearance to which the term "bilious" was applied, it was formerly supposed that rhubarb had the power to increase the flow of bile; more recently it has been universally conceded that the coloring-matter of rhubarb produces the peculiar tint referred to. The latest investigations of Rutherford and Vignal have, apparently, very conclusively shown that rhubarb really possesses the property anciently ascribed to it, and that it must be placed among the cholagogue medicines. As it is now known to increase the flow of bile, it may be assumed that the intestinal secretions in general are promoted by it. These effects, which indeed are produced by all the purgatives containing a resin, are probably due to phæoretin—the rhubarb resin.

The coloring-matters of rhubarb stain the perspiration, milk, and urine, and the milk acquires a bitter taste and purgative properties.

THERAPY.—The infusion of rhubarb is frequently employed as a vehicle for the administration of alkalies and mineral acids in *stomachic disorders.* In small doses, the tincture is an excellent *stomachic tonic* in *dyspepsia* with deficient biliary and intestinal secretions. It is adapted to those of a relaxed habit, and is inadmissible when a hyperæmia of the mucous membrane exists.

Rhubarb is a remedy of the greatest utility in the *duodenal catarrh*, and in the *catarrh of the biliary ducts with jaundice*, as these maladies occur in children. The passing of whitish, pasty, or clay-colored stools, while the skin presents an earthy or jaundiced hue, is the indication for the use of rhubarb. It is true that the stools will be quickly stained, so as to present the bilious character, without any improvement having necessarily taken place in the local malady; but it is also true that rhubarb is curative in the conditions above described. In the *summer diarrhœa* of children, no remedy is more generally prescribed. The aromatic sirup of rhubarb is a pleasant form in which to administer it. In this disorder, especially if the motions are sour, alkalies should be prescribed with the rhubarb. Magnesia, chalk, or sodium carbonate, may be given with the powder of rhubarb, the fluid extract, or the sirup. The following is an excellent formula in these cases: ℞ Infus. rhei, ℥ iij; potassii bicarb., ʒ j; tinct. cinnamomi, ʒ ij; syrp. simplicis, ʒ vj. M. Sig.: *A teaspoonful every hour or two in cholera infantum. Diarrhœa* in children or adults, due to the presence of undigested food, or retained irritating secretions, may not unfrequently be cured by a purgative dose of some rhubarb preparation. After the purgative effect is expended, the bowels are confined by the astringent. In acute dysentery the saline purgatives are much more appropriate than rhubarb.

In *habitual constipation* good effects may be obtained by chewing some rhubarb-root. The astringent after-effect is, however, a decided objection to the frequent use of this remedy for this purpose. In the rhubarb-pill the astringency is counteracted by soap. The compound rhubarb-pill, which contains aloes, is a mild and efficient cathartic.

Aloe.—Aloes. The inspissated juice of the leaves of *Aloe Socotrina* Lamarck (Nat. Ord. *Liliaceæ*).

Aloe Purificata.—Purified aloes. In brittle pieces of a dull-brown or reddish-brown color, and having the peculiar aromatic odor of Socotrine aloes. It is almost entirely soluble in alcohol. (U. S. P.) Dose, gr. j—grs. v.

Extractum Aloës Aquosum.—Watery extract of aloes. Dose, gr. ss—gr. v.

Pilulæ Aloës.—Pills of aloes. Each pill contains two grains of aloes and two grains of soap. Dose, 1—5 pills.

Pilulæ Aloës et Asafœtidæ.—Pills of aloes and asafœtidæ. (Aloes, asafœtidæ, and soap, in equal parts.) Dose, 2—5 pills.

Pilulæ Aloës et Mastiches.—Pills of aloes and mastic. Lady Webster's pills. (Aloes, mastic, and red rose.) Dose, 1—2 pills.

Pilulæ Aloës et Myrrhæ.—Pills of aloes and myrrh. (Aromatic powder, myrrh, aloes.) Dose, grs. v—grs. xv.

Tinctura Aloës.—Tincture of aloes. Dose, ʒ ss—℥ j.

Tinctura Aloës et Myrrhæ.—Tincture of aloes and myrrh. Dose ʒ ss—ʒ ij.

Vinum Aloës.—Wine of aloes. Dose, ʒ j—℥ ss.

Pulvis Aloës et Canellæ.—Powder of aloes and canella (hiera picra). Dose, grs. v—℈j. (Not official.)

Composition.—The odor of aloes is due to a peculiar *volatile oil.* It contains also a *resin,* and a principle, *aloïne.* The composition of aloïne is not precisely the same in the different varieties of aloes. The Barbadoes aloes furnishes *barbaloïne,* the Natal aloes, *nataloïne,* and the Socotrine aloes, *soaloïne.* These varieties, it is supposed, constitute an homologous series.

Actions and Uses.—Aloes has a bitter and very disagreeable taste, leaving a rather acrid after-sensation in the fauces. It is a stomachic tonic, and, like bitters in general, it promotes the appetite and digestion. Accordingly, it is much prescribed as a stomachic tonic in cases of *indigestion with torpor of the large intestine.* Irritable or inflammatory states of the stomach mucous membrane contraindicate its employment.

The recent investigations of Rutherford and Vignal have shown that aloes has the power to stimulate the hepatic functions, and to promote the flow of bile. This result is confirmatory of clinical experience. In large doses (twenty grains or more) aloes undoubtedly increases the intestinal secretions generally ; but, in the ordinary medicinal laxative dose, the stools are not liquid, and are but little altered in character. The principal effect of aloes is expended on the large intestine, the peristaltic movement of which it increases. Some tormina is experienced when the laxative effect begins, and tenesmus, with heat and irritation of the rectum, is produced when an active purgative dose has been taken. The blood-supply to the pelvic organs is increased by aloes ; the menstrual flow becomes more abundant, and abortion, it is said, may be caused by its incautious administration ; while in the male, erections take place more frequently.

Ten or twelve hours elapse after it has been swallowed, before cathartic effects are produced. The rate at which it moves to affect the intestinal canal is influenced less by the size of the dose than by the condition of the bowels.

The purgative principle of aloes diffuses into the blood. Applied to an exposed surface, it is absorbed and purges, and the milk of mothers taking it acquires a purgative action.

Simple *jaundice,* of an atonic kind, may be cured by aloes. No purgative is more efficient in *constipation,* dependent on weakness and impaired contractility of the muscular layer of the large intestine. Jaundice, or at least a bilious state, a coated tongue, foul breath, a tumid abdomen, and an impacted colon, are conditions frequently associated and are readily relieved by aloes. The constipation of *hypochondriasis* and *melancholia* is best overcome by the use of this agent, and, with the removal of the impacted fæces, there is not unfrequently an improvement in the mental state. Aloes is prescribed in *cerebral disorders,* when purgatives are given with a view to a derivative effect.

In *amenorrhœa* which is dependent on anæmia, aloes is prescribed, with other appropriate remedies, to determine an afflux of blood to the uterine system. *Menorrhagia,* occurring in debilitated and relaxed subjects, is sometimes relieved in the same way. Iron may be associated with aloes in these cases. Congestion of the pelvic viscera is a contraindication to the use of aloes, and the existence of hæmorrhoids, or of a tendency therefor, has heretofore been considered an equally positive contraindication. Fordyce Barker has, however, shown that aloes has a curative power in certain cases of *hæmorrhoids,* and notably those which occur after delivery. The local condition, under these circumstances, is not one of active hyperæmia, but really consists in a sluggish state of the circulation in the inferior hæmorrhoidal veins. It can hardly be doubted that aloes would increase the trouble if prescribed for cases in which there was active congestion of the pelvic viscera. Barker also advocates the use of aloes in non-puerperal *hæmorrhoids,* but the local condition must be suitable for the use of this remedy or the disease will be aggravated. The following are formulæ proposed by Barker: ℞ Pulv. aloës Soc., sapo. Cast., āā ℈j; ext. hyoscyami, ʒ ss; pulv. ipecacuanhæ, grs. v. M. Ft. pil. no. xx. Sig.: *One pill morning and evening.* When the hæmorrhoids are associated with an irritable rectum, and with frequent, small, teasing, thin evacuations, Barker substitutes for the hyoscyamus a small quantity of opium, giving also a less quantity of the aloes, as in the following formula: ℞ Ferri sulph., ℈j; pulv. aloës Soc., ext. opii aq., sapo. Cast., āā grs. x. M. Ft. pil. no. xx. Sig.: *One pill morning and evening.* Oppolzer also used aloes as a remedy for hæmorrhoids, prescribing, when there was constipation, aloes and quinine, and, when the bowels were not confined, aloes and sulphate of iron.

The action of aloes, as well as of other resin-bearing purgatives, in the condition of anæmia, is promoted by the conjoined use of the bitters, quinine, iron, and tonics generally. Two grains of aloes, taken at bedtime, will cause a satisfactory evacuation on the following day. Combination with soap, as in the official pil. aloës, and pil. aloës et asafœtidæ, diminishes the drastic, while it increases the efficiency of the purgative, action. It is generally better to give aloes by itself, without combination with other cathartics; but its purgative effects may be greatly enhanced by administering a saline laxative six or eight hours after the aloes has been taken.

A *gonorrhœa* may, it is said, be cured by the internal use, three times a day, of a pill containing two or three grains of aloes. *Catarrh of the uterus* has been treated successfully by aloes rectal enemata. The tincture of aloes, diluted to one half or even more, by water, is a very effective injection in gonorrhœa after the acute symptoms have subsided.

Jalapa.—Jalap. The tuberous root of *Ipomea jalapa* Nuttall (Nat. Ord. *Convolvulaceæ*). *Racine de jalap*, Fr.; *Jalape*, Ger.

Extractum Jalapæ Alcoholicum.—Dose, gr. ½—gr. ij.

Resina Jalapæ.—Resin of jalap. Dose, gr. ij—gr. v.

Pulvis Jalapæ Compositus.—Compound powder of jalap. (Jalap, 35 grm.; bitart. of potassa, 65 grm.) Dose, gr. x—ʒ j.

Composition.—Jalap contains a *resin*, to which its purgative property is due. The resin consists of two varieties, one soluble, the other insoluble, in ether. The latter has been named *convolvulin*, or *jalapin*, and is the more active purgative of the two. Various secondary products of considerable interest are obtained from the resin, but these possess no special importance from the therapeutical point of view.

Physiological Actions.—As a cathartic jalap resembles, but it is much more active than, senna. It is apt to produce nausea, and tormina and tenesmus invariably accompany its purgative action. It usually operates in from two to four hours, but the rate at which it moves to affect the intestinal canal is not influenced by the amount administered. The stools are soft at first, and afterward liquid. Jalap does not produce hæmorrhoids, nor does it cause a tendency to, or increase an existing, menorrhagia. The secretions of the intestinal canal are increased by it, and the recent researches of Rutherford and Vignal have demonstrated that jalapin (convolvulin) excites the flow of bile.

The action of jalap appears to be local. It is true that experiments in support of a contrary opinion have been made; but, in the conclusive test of the intra-venous injection of convolvulin, no purgative action has followed (Husemann).

Therapy.—The resin of jalap being the active constituent, it should generally be preferred. It has the merit of being almost tasteless, and hence may be given readily to children.

Jalap is an efficient cathartic in the beginning of *fevers, inflammations*, and *acute diseases* requiring the use of such therapeutic means. Formerly calomel and jalap were much prescribed, but this combination has deservedly fallen into discredit. Occasionally the resin and calomel, in less ponderous doses than formerly given, may be used with advantage as a cathartic: ℞ Resinæ jalapæ, hydrarg. chlor. mit., ext. hyoscyami, āā gr. j. M. Ft. pil. no. j. Sig.: *Take at bedtime.*

As jalap in sufficient quantity causes free watery evacuations, it is a suitable purgative in *anasarca* and *ascites*. The most generally approved hydragogue purgative, under these circumstances, is the compound jalap-powder. The efficiency of this may be increased by the addition of podophyllum. A teaspoonful of the compound powder, taken in the early morning, will usually produce several very copious, watery stools. Increased urinary discharge also is a not unfrequent result of its action.

Jalap has the power to cause the expulsion of *lumbrici*. As a vermifuge it is not at all equal to the other approved remedies, but it is certainly useful as an adjunct. For example, santonin at night, and the resin of jalap and calomel on the following morning, is an effective method of expelling these parasites.

Jalap is, of course, contraindicated in inflammatory states of the intestinal canal. In overdoses it causes hypercatharsis, and it may excite violent gastro-enteritis and endanger life. With proper attention to the conditions in which it is admissible, and to the dosage, jalap is entirely safe, and is a very certain and efficient cathartic. An excellent vehicle for the administration of the resin of jalap is the sirup of rhubarb. ℞ Resinæ jalapæ, grs. ij—grs. v; syr. rhei aromat., ℥ ss. M. This is especially suitable for children.

Scammonium.—Scammony. A resinous exudation from the living root of *Convolvulus scammonia* Linné (Nat. Ord. *Convolvulaceæ*). (U. S. P.) *Scammonée*, Fr.; *Scammonium*, Ger.

Resina Scammonii.—Resin of scammony. Dose, grs. v—grs. x.

Composition.—The activity of scammony, as a cathartic, depends entirely on the *resin* which it contains. As the crude scammony is much adulterated, the resin is alone worthy of confidence.

Actions and Uses.—Scammony corresponds very closely to jalap in the time it requires to cause cathartic action, in the character of the stools produced, and in the kind of irritation which it excites. Scammony is somewhat more drastic than jalap. As it has but little taste, and is at the same time very active, the resin is much prescribed by English practitioners as a cathartic for children. It may be given rubbed up with milk, or with sirup of rhubarb. It is adapted to the same class of cases, and to the relief of the same conditions, as jalap.

Colocynthis.—Colocynth. The fruit, deprived of its rind, of *Citrullus colocynthis* Schrader (Nat. Ord. *Cucurbitaceæ*). (U. S. P.) *Coloquinte*, Fr.; *Koloquinten*, Ger.

Extractum Colocynthidis.—Extract of colocynth.

Extractum Colocynthidis Compositum.—Compound extract of colocynth. (Extracts of colocynth, scammony, and aloes; cardamoms, soap.) Dose, grs. v—grs. x.

Pilulæ Catharticæ Compositæ.—Compound cathartic pills. (Compound extract of colocynth, abstract of jalap, calomel, gamboge.) Dose, 1—3 pills. Each pill contains one grain of calomel.

Composition.—Colocynth contains a bitter principle (*colocynthin*), which is the purgative principle. *Colocynthitin* is another substance contained in the alcoholic extract. It differs from colocynthin in being soluble in ether, and not in water. As colocynthitin is a tasteless crystalline powder, it is probably devoid of purgative property. Colocynthin is a very powerful cathartic.

Actions and Uses.—Colocynth is a gastro-intestinal irritant. In moderate doses it hastens the peristaltic movements, and increases the intestinal secretions. Its cathartic operation is usually attended with griping, and the stools are fluid. Violent gastro-enteritis may be produced by a large quantity, and numerous fatal cases have been reported from its incautious or criminal administration.

The action of colocynth is not merely local. Applied to the skin of the abdomen, it causes intestinal pain, and more frequent alvine discharges.

Colocynth is never administered alone, but usually in combination with other purgatives. The compound extract is a safe, effective, and not unpleasant cathartic for the relief of *constipation.* ℞ Ext. colocynthidis comp., ℈j; ext. belladonnæ, ext. physostigmatis, āā grs. v. M. Ft. pil. no. x. Sig.: *One each night in habitual constipation.* The official compound cathartic pill is a most serviceable combination. Instead of calomel the resin of podophyllum may be used in the preparation of this pill, without impairing its utility.

In *cerebral congestion* the preparations of colocynth are used as derivative purgatives. *Hypochondriasis* and *melancholia,* when associated with torpor of the large intestines and fecal accumulations, are benefited by brisk purging with the colocynth preparations, but other drastic purgatives are equally efficient.

Colocynth is inadmissible in inflammatory states of the intestinal canal, and is unsafe during the existence of pregnancy. There is a popular notion, which has led to its use in toxic doses, that colocynth may cause abortion. Any quantity which will affect the gravid womb must be sufficient to endanger life.

Podophyllum.—May-apple. The rhizoma and roots of *Podophyllum peltatum* Linné (Nat. Ord. *Berberidaceæ*).

Resina Podophylli.—Resin of podophyllum. Dose, gr. ¼—gr. j.

Extractum Podophylli.—Extract of podophyllum. Dose, gr. v—gr. x.

Extractum Podophylli Fluidum.—Fluid extract of podophyllum. Dose, ♏ j—ʒ ss.

Composition.—The medicinal qualities of podophyllum are due to a *resin,* or to two resinous substances, one soluble in alcohol and ether, and the other soluble in alcohol only. Both possess purgative properties. May-apple-root contains the alkaloid *berberine,* which, however, contributes nothing to the therapeutical properties of this remedy, and, further, it is not peculiar to podophyllum, being found in berberis, hydrastis, and other plants.

Resina podophylli is the preparation entitled "podophyllin" by the eclectic practitioners.

Actions and Uses.—The taste of podophyllum is bitter, with an after-sense of acridity. It increases the intestinal secretions, and is actively cathartic, producing copious and rather watery stools. Its action is similar to, but considerably slower than, that of jalap. From six to ten hours elapse after its administration before cathartic effects are experienced. Taken by itself, it is apt to cause nausea and griping, but in combination with other cathartics, or with belladonna or hyoscyamus, it operates pleasantly as well as efficiently. The Edinburgh committee, Dr. Bennett, chairman, ascertained, as they supposed, that the resin of podophyllum has no cholagogue action, but the more recent as well as the more accurately conducted experiments of Rutherford and Vignal have apparently demonstrated that it decidedly increases the flow of bile, corresponding in this particular to the other resinous cathartics.

Podophyllum-resin is the most generally useful cathartic in cases of *constipation*, in which the secretions of the glandular apparatus of the intestinal canal, and of the liver, are deficient. *Habitual constipation*, due to torpor of the muscular layer of the bowel, may, it is said, be removed by the nightly use of a small dose of the resin combined with belladonna. ℞ Resinæ podophylli, grs. vj ; ext. belladonnæ, ext. physostigmatis, āā grs. iij. M. Ft. pil. no. xij. Sig. : *One pill each night.* It is especially in *congestion of the portal circulation*, in *catarrhal* and *malarial jaundice*, and in *ascites*, that podophyllum-resin acts most efficiently and serviceably. *Hæmorrhoids* that bleed in consequence of stasis in the portal circulation, and that are of recent formation, may sometimes be cured by a brisk podophyllum cathartic.

The clinical experience which had shown that the resin of podophyllum possessed cholagogue powers, long before the experimental inquiry was instituted to settle the question, led also to a wide generalization in the therapeutical uses of this agent. Acting on the liver, it was assumed that, in a manner similar to mercury, it must also possess similar "alterative" powers. It came to be used as the "vegetable calomel," in the diseases in the treatment of which mercury was supposed to be essential. It need hardly be asserted that these speculations have no basis, and that podophyllum possesses no property in common with mercury except its power to purge.

Leptandra.—Leptandra. The rhizoma and roots of *Leptandra virginica* Linné (Nat Ord. *Scrophulariaceæ*).

Extractum Leptandræ.—Extract of leptandra. Dose, gr. ij—gr. x.

Extractum Leptandræ Fluidum. — Fluid extract of leptandra. Dose, ♏ v — ʒ j.

Composition.—A crystallizable principle has been obtained from the root—*leptandrin* (?). It contains also a *resin* which, in the impure form at present found in commerce, has a distinctly purgative quality and is known as *leptandrin.* The dose of this preparation is gr. ij—gr. v.

Actions and Uses.—Leptandra is an active cathartic in the recent state. In the form of the fluid extract, or of the so-called leptandrin, it acts mildly, causing somewhat liquid and apparently bilious stools. It is held to be cholagogue, and, according to the rules of analogy, this claim may be well founded, for other cathartics containing resin, as the experiments of Rutherford and Vignal have shown, possess the power to increase the flow of bile.

It is applicable to cases of disease of the intestinal canal, attended by constipation, in which the biliary and intestinal secretions are insufficient.

Iris.—Blue flag. The rhizoma and roots of *Iris versicolor* Linné (Nat. Ord. *Iridaceæ*).

Extractum Iridis.—Extract of iris. Dose, gr. j—gr. v.

Extractum Iridis Fluidum.—Fluid extract of iris. Dose, ♏ v — ʒ j.

Under the name *iridin*, there is to be found in the shops a "resinoid," having more or less of the properties of the crude drug. The dose of this preparation is from one to five grains.

Actions and Uses.—Iris versicolor has a bitter, nauseous, and rather acrid taste. It is apt to cause severe nausea. The fresh root has actively purgative and diuretic qualities, but these are impaired by age. The fluid extract and the "iridin" are laxative, and are supposed to have cholagogue powers.

The oleo-resin is prescribed in *hepatic* and *intestinal disorders*, and in *dropsy.* There is much evidence tending to show that this remedy is really serviceable when the stools are clay-colored, and the skin jaundiced, in consequence of duodenal catarrh and obstruction of the biliary ducts. It is said that *malarial jaundice* may be cured by this drug, and that in *bilious remittent fever* and in *chronic malarial poisoning* it exerts a favorable influence.

Euonymus.—Wahoo. The bark of *Euonymus atropurpureus* Jacquin (Nat. Ord. *Celastraceæ*).

Extractum Euonymi.—Extract of enonymus. Dose, gr. j—gr. v.

The eclectic preparation (euonymin) consists of the resin and fixed oil, and is prescribed in the dose of a half-grain to five grains.

Composition.—An uncrystallizable and intensely bitter principle has been isolated (*euonymin*). It contains also a crystallizable, a yellow and a brown resin, fixed oil, etc.

ACTIONS AND USES.—Euonymus possesses cathartic properties similar to rhubarb, but is much milder, and is an excellent remedy in hepatic and intestinal disorders requiring the use of such an agent. The eclectic preparation (euonymin) is a convenient form in which to procure the cathartic action of euonymus. Rutherford has shown that it is a highly efficient cholagogue.

Baptisia.—Wild indigo. The root-bark of *Baptisia tinctoria.* (Not official.) Preparations corresponding to those of iris and euonymus can be obtained.

Extractum Baptisiæ.—Extract of baptisia. Dose, gr. j—gr. x.

Baptisin, the resinoid, is much prescribed by eclectic practitioners. The dose is one to five grains.

ACTIONS AND USES.—The taste of baptisia is bitter and somewhat acrid. It increases the secretions of the glandular appendages of the gastro-intestinal mucous membrane. It possesses in large doses emeto-cathartic property, and may indeed excite violent gastro-intestinal inflammation ; in small doses it is merely laxative. The resinoid *baptisin*, so called, has been studied by Rutherford, who found it to possess active cholagogue property. Given to dogs, it distinctly stimulates the hepatic functions and increases the production of bile. It is probable that it deserves to rank among the most efficient of the remedies of this group. It is indicated, therefore, in all the cases in which hepatic stimulants are desirable.

HYDRAGOGUE CATHARTICS.

Cambogia.—Gamboge. A gum-resin obtained from the *Garcinia Hanburii* Hooker *filius* (Nat. Ord. *Guttiferæ*). (U. S. P.) *Gommegutte*, Fr. ; *Gummigutt*, Ger. Dose, gr. j—grs. v.

The only official preparation is the compound cathartic pill, of which gamboge constitutes about a tenth part.

COMPOSITION.—Gamboge is a mixture of resin and gum, the latter constituting from fifteen to twenty per cent.

ACTIONS AND USES.—Gamboge has no taste at first, but, when chewed, an acrid sensation is developed in the mouth. It is irritant to the gastro-intestinal canal, increases secretion of the glands, excites vomiting and intestinal pain, and purges violently, producing copious watery stools. The experiments of Rutherford and Vignal show that gamboge is not an hepatic stimulant, but does cause hydrocatharsis. Violent gastro-enteritis is set up by large doses, yet but few fatal cases have been reported. As vomiting soon follows the ingestion of a large dose, this fact may explain the rarity of a fatal result due to its administration.

Gamboge is rarely prescribed alone as a cathartic, owing to the violence and harshness of its operation. Combination with other cathartics, as in the compound cathartic pill, greatly modifies its action. As it is a powerful hydragogue cathartic, it is given with advantage in *dropsy*, when hydrocatharsis is indicated. It is best administered in small doses, at short intervals, rubbed up with sugar or made into a pill with soap. Besides its purgative properties, gamboge is decidedly *diuretic*. In order to obtain its diuretic effects it must be given in small doses, at short intervals, and vomiting must be avoided. Administered in solution with an alkaline diuretic, its efficiency is much increased. Gamboge has also been used as an *anthelmintic*, but it has no powers in this respect not possessed by other drastic purgatives.

Oleum Tiglii.—Croton-oil. A fixed oil expressed from the seeds of *Croton tiglium* Linné (Nat. Ord. *Euphorbiaceæ*). (U. S. P.) *Huile de Croton*, Fr.; *Crotonöl*, Ger. Dose, gt. j—gtt. ij.

Composition.—It contains glycerides of the fatty acid series—stearic, palmitic, myristic, and lauric acids—and the more volatile acids, acetic, butyric, and valerianic (Flückiger and Hanbury, Husemann). Genther and Fröhlic have discovered a peculiar volatile acid, to which they have applied the name *tiglinic acid*. By the same chemists the so-called *crotonic acid* is held to be an artificial product. Schlippe has asserted the discovery of the vesicating principle of croton-oil, but other chemists have failed to find this substance, to which he has assigned the name of *crotonol*. The purgative principle of the oil appears to exist in all parts of the *Croton tiglium*, but it has not yet been isolated.

Actions and Uses.—Croton-oil is a transparent or semitransparent viscid liquid, amber-colored, and having a rather rancid smell, and an oily, acrid taste. Applied by friction to the skin, it excites inflammation, and causes an eruption which is at first papular, with rounded summits, and afterward becoming pustular. The eruption is sometimes umbilicated, but is generally rounded. An areola surrounds the pustules, and there are considerable heat and burning in the part. The eruption appears in a few hours after the frictions have been practiced, reaches its maximum in about four days, and then declines by abortion of the pustules and by scabbing. In many subjects permanent, small white cicatrices mark the site of the eruption. All subjects are not equally susceptible to the vesicating action of croton-oil.

The mucous membrane is violently attacked by croton-oil. In the fauces it causes an intensely acrid sensation, and increases the flow of saliva. A sense of heat, pain, and nausea is produced when the oil is received into the stomach, tormina soon follows, and in an hour or two watery stools are passed with some burning and irritation about the anus. The action of the oil continues during the succeeding twelve to twenty-four hours, numerous fluid dejections are passed, and considerable debility is the result. When large doses are taken, if not rejected promptly by vomiting, violent hypercatharsis occurs with great prostration and collapse. Fortunately, when an overdose is swallowed, vomiting quickly ensues, and hence very large quantities have been taken without producing a fatal result. The lesions caused by croton-oil are those of gastro-enteritis, but fatal cases have occurred, with all the objective phenomena of choleraic collapse, without any evidences of local inflammation.

As croton-oil is still purgative after being deprived of its acrid principle by washing with alcohol, it has been held that the oil becomes cathartic only by the action of the alkaline juices of the duodenum. Numerous instances have been reported, and some have fallen under the author's observation, in which croton-oil applied to the integument has produced diarrhœa. It must, therefore, act by absorption into the blood. In some cases, without causing purging, croton-oil affects the nervous system in a peculiar manner. Thus restlessness, palpitation of the heart, headache, giddiness, confusion of ideas, etc., have occurred under these circumstances (Husemann).

Röhrig found that croton-oil stimulated the hepatic function, and increased the flow of bile. Radziejewski found peptones, bile, glycogen, leucin, and tyrosin, in the stools. Rutherford and Vignal have since shown that croton-oil, although it causes great vascular dilatation of the vessels of the intestinal mucous membrane, can not be regarded as a cholagogue.

The principal effect of croton-oil, for which it is administered in medical practice, is that of a *hydragogue cathartic*. It is, therefore, used in *dropsies* when it is desired to procure free, watery evacuations. It is inadmissible when there is much debility, or when an irritable or inflammatory state of the intestinal mucous membrane exists.

Notwithstanding its great activity, croton-oil is an easily-managed cathartic for ordinary purposes. It is the most efficient purgative when there is simple *impaction*, without inflammatory symptoms. The *constipation from lead* may be overcome by it, when less powerful purgatives will fail. It is the most appropriate of cathartics, when these agents are indicated as *revulsives in cerebral congestion*. Croton-oil, by increasing the vascular dilatation in the intestines, lowers the intracranial blood-pressure. *Per contra*, it is harmful when a state of cerebral anæmia exists.

Croton-oil has been used successfully against *tænia*, but it has no special vermifuge property.

The smallness of the dose required renders croton-oil a very useful purgative in the maladies of children and of the insane. When the patient is unable to swallow from insensibility or paralysis, a drop or two placed on the tongue will act efficiently. It may be given to children, rubbed up with sugar of milk. As washing with alcohol removes the acridity, and does not impair the purgative property, a preparation so treated will be best for administration to children. The unpleasant effects of this remedy may be much modified by combination with other cathartics. ℞ Ol. tiglii, gtt. iij; ext. colocynth. com., ℈j; ext. belladonnæ, grs. iij. M. Ft. pil. no. vj. One of these will usually act efficiently. The following is the formula of Dr. Francis's "triplex pills": ℞ Aloes socot., scammonii, pil. hydrargyri, āā ℥j; ol. tiglii, ♏ xx; ol. carui, ♏ xc; elix. proprietatis, q. s. M. Ft. pil. no. 400. *Dose, as a laxative, one at bedtime.* This combination is very popular in New York.

Elaterium.—Elaterium. A substance deposited by the juice of the fruit of *Momordica elaterium, Ecbalium agreste.* (Not official.) *Concombre purgatif*, Fr.; *Springgurke*, Ger. Dose, gr. $\frac{1}{16}$—gr. $\frac{1}{4}$.

Composition.—The important constituent of elaterium is *elaterin.* Owing to the uncertainty in the strength of elaterium, it has been omitted from the official list, and its active constituent substituted.

Elaterinum.—*Elaterin.* A neutral principle extracted from elaterium, a substance deposited by the juice of the fruit of *Ecbalium elaterium* A. Richard (Nat. Ord. *Cucurbitaceæ*).

Small, colorless, shining hexagonal scales or prisms, permanent in the air, odorless, having a bitter, somewhat acrid taste, and a neutral reaction. Insoluble in water; soluble in 125 parts of alcohol at 60° Fahr. Dose, gr. $\frac{1}{20}$—gr. $\frac{1}{8}$.

Trituratio Elaterini.—Trituration of elaterin. (Elaterin, 10 grm.; sugar of milk, 90 grm.) Dose, gr. ss—gr. ij.

Actions and Uses.—Elaterium excites an abundant flow of saliva, and a persistent bitter taste is experienced in the fauces some time after it is swallowed. Nausea and vomiting, profuse, watery stools, and great weakness and prostration, are produced by a considerable dose of elaterium. The vomited matters and stools have an appearance and composition similar to the "rice-water" discharges of cholera. On animals elaterium acts somewhat differently. Without causing purging, it affects the nervous system, producing irregular respiration, hebetude, convulsions, and death (Köhler). The gastro-intestinal action is doubtless local, and the result of the immediate impression made by the agent in its passage down the intestinal canal. According to Köhler, the presence of bile is necessary to the action of elaterium.

The chief use of elaterium is to procure free watery evacuations in *ascites, general dropsy, uræmia,* and to act as a revulsive in *cerebral disorders.* It must be used with caution in debilitated subjects. Gastro-intestinal irritation, or inflammation, contraindicates its use. The depression which its operation induces must be counteracted by stimulants and proper aliment.

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Enemata.—An *enema* is a rectal injection. The capacity of the rectum, it need hardly be stated, varies with the age of the individual. For an infant, half an ounce to an ounce; for a child of two to five years, two to six ounces; for five to fifteen years, six ounces to a pint; for an adult, a pint to a quart of fluid may be considered as an approximation to the capacity of the rectum at these ages respectively. Habitual use of injections no doubt increases the tolerance, as also the capacity of the rectum.

Injections may consist of water—cold, tepid, warm, or hot; of medicated solutions—emollient, anodyne, laxative, cathartic, or anthelmintic. Under this head are to be considered only enemata administered with the view to cause an evacuation from the intestinal canal.

Enemata act either by a reflex irritation or by absorption. When a cold injection is thrown into the rectum, or this organ is distended, an action is set up for the expulsion of the offending substance, and the muscular fiber of the bowel more or less vigorously contracts according to its functional condition. The quantity, as well as the temperature of the fluid injected, must therefore be taken into consideration, when it is proposed to empty the bowels by a merely reflex irritation. On the other hand, when it is the intention to procure the absorption of the medicated fluid, the quantity injected must be relatively small, and its temperature should, as nearly as possible, be that of the rectum. In order to secure absorption, it is necessary also to regard the laws of diffusion. As the secretions of the rectum are alkaline, it is obvious that acidulated solutions will diffuse into the rectal veins with the greatest facility. It is doubtful whether colloidal substances of themselves are taken up in the rectum. (See NUTRIENT ENEMATA, p. 55.)

Irrigation of the intestines, or *forced injections* of a large quantity of water, is a modern expedient of great practical utility. The apparatus required for the performance of this operation consists of a rectal tube, a flexible rubber pipe three or four feet in length, and a funnel-shaped vessel to contain the fluid to be injected. The decubitus on either side, the hips being elevated, may be sufficient; but, to insure gravitation of the fluid to the ileo-cæcal valve, the female patient should be placed in Sims's position, and the male patient on his hands and knees. The rectal tube should be inserted, and passed up to the sigmoid flexure; the flexible tube should then be attached. The height to which the reservoir is raised will regulate the hydrostatic pressure, and the flow of fluid through the flexible tube can be lessened or increased at the pleasure of the operator by compression with the fingers.

In administering rectal injections the utmost gentleness is requisite, especially when a large amount of fluid is to be introduced. Rude thrusting of the pipe into the rectum may injure the mucous membrane, and rapid and forcible dilatation of the bowel will excite an imperious desire to go to stool. Too great pressure, in the process of irrigation, may cause a rupture of the intestine, especially if its coats are softened by disease or penetrated by ulceration. It is possible that sudden and forcible distention of the bowel may produce dangerous cardiac syncope in susceptible subjects.

The experiments on the cadaver have demonstrated that, although the large intestine may be filled with water, no fluid can be made to pass the ileo-cæcal valve. Notwithstanding these experiments, it has been claimed that in the living subject, by the irrigation method, water can be forced through the whole length of the intestine. If these observations are correct, it is probable that a pathological state of the ileo-cæcal valve must have existed.

FORMS OF ENEMATA.—*Enema Aloës.*—℞ Aloës, ℈ij; potassii carbonat., grs. xv; mucil. amyli *vel* decoct. hordei, ℥x. (B. P.)

Enema Magnesii Sulphatis.—℞ Magnesii sulphat., ℥j; ol. olivæ, ℥j; mucil. amyli *vel* decoct. hordei, ℥xv. Dissolve the sulphate of magnesia in the mucilage, then add the oil. (B. P.)

Enema Terebinthinæ.—℞ Ol. terebinthinæ, ℥j; mucil. amyli *vel* decoct. hordei, ℥xv. (B. P.)

Enema Ol. Ricini et Terebinthinæ.—℞ Ol. terebinthini, ℥ss; ol. ricini, ℥jss; ovi, j; decoct. hordei *vel* aq. fervid., ℥xiv.

A common domestic enema consists of soap-suds, made somewhat more stimulating to the rectum by the addition of turpentine.

THERAPY.—A pint of cold water is a good enema for cases of habitual constipation, especially when there are hæmorrhoids which bleed with every motion. The enema of aloes, in quantity corresponding to the age of the subject, is an efficient remedy for the destruction of *ascarides vermiculares.*

The purgative enemata above given are employed to act on the large intestine, chiefly by virtue of reflex stimulation, but, in part, absorption of the purgative principle takes place, whence it follows that they may affect the whole canal. They are used, therefore, as cathartics, and for the ordinary purposes of these remedies. The purgative enemata are not suitable for habitual use. They excite irritation of the rectum, which may result in ulceration, ischio-rectal abscess, *fistula in ano*, fissure of the anus, and other serious accidents.

Irrigation of the bowel is resorted to for the removal of *impacted fæces*, to overcome *intussusception*, etc.

Cases of intestinal invagination have been very quickly relieved by sudden inflation of the large intestine with carbonic acid. The process consists in the injection of a solution of sodium bicarbonate, followed by a solution of tartaric acid—about one drachm of each to eight ounces of water. The escape of the gas through the *sphincter ani* must be prevented by forcible pressure upon the anus.

Suppositoria Aloës.—(Aloes and cacao-butter.) Each suppository contains about five grains of purified aloes. One of these, introduced into the rectum at night, will generally procure one or two evacuations on the following day. It is not good practice to employ such a method of treatment frequently.

A piece of hard white soap cut into a conical shape, and of a suitable size, is frequently used in domestic practice to relieve the *constipation of infants.* The soap suppository thus prepared is carefully introduced into the rectum. The habit of a daily evacuation may be thus induced. A piece of paper rolled into a conical shape, and dipped into oil, may be used instead of the soap suppository.

ANTHELMINTICS.

Anthelmintics are remedial agents used to cause the expulsion of parasites from the intestinal canal. *Vermifuges* are remedies which expel worms; *vermicides* are remedies which kill as well as expel worms. Some of these agents act mechanically, as mucuna and powdered tin; others are administered in such quantity as to sicken and disable the worms, when their expulsion is easily effected: for example, pumpkin-seed emulsion. Others again possess narcotic and toxic properties, as turpentine, chenopodium, santonin, etc.

Anthelmintics are conveniently divided into those employed against ascarides vermiculares, those employed against ascarides lumbricoides, and those employed against the different varieties of tænia.

Ascarides vermiculares infest the rectum and large intestine, extending up occasionally as high as the ileo-cæcal valve; in females, they may also spread into the vagina. As they deposit their ova in the folds of the anus, and in the vagina, it is obvious that the parasiticide, to be effective, must be applied in these situations.

Infusion of quassia, decoction of aloes, and a weak solution of carbolic acid, are the most frequently-prescribed remedies for the destruction of ascarides. If carbolic acid is used, the strength of the injection for children should not exceed ten grains to the pint, and it should not be retained. Infusion of quassia is at the same time safe and effective; but, when this injection is used, a solution of carbolic acid should be applied also, by means of a sponge, to the folds of the anus, and, in the case of female children, to the external genitals. If the ascarides extend up into the large intestine beyond the sigmoid flexure, a dose of santonin and calomel should precede the use of the rectal parasiticide.

REMEDIES USED FOR THE EXPULSION OF ASCARIDES LUMBRICOIDES.

Mucuna.—Cowhage. The hairs of the pods of *Mucuna pruriens*. This remedy is now rarely if ever used. It is administered in the form of electuary, mixed with molasses. A teaspoonful or more of the mixture should be administered fasting, and after the action of a cathartic. When several doses have been taken a brisk purgative should be given.

When cowhage is applied to the skin it excites intense itching, inflammation in the skin, and pustulation. It has been proposed as a counter-irritant, but a more disagreeable one could hardly be conceived. It is very irritant to the intestinal mucous membrane, as it is to the skin, and an action is speedily set up for its expulsion. When by the use of a purgative, and by reason of fasting, intestinal worms are uncovered and exposed to attack, it is held that the mucuna-hairs pierce the parasites and irritate them, so that their stay in the intestine is rendered intolerable. In consequence of the active peristaltic movements induced by the cowhage, and by the purgative with which it is followed, the worms are hurried out with the remaining contents, if any, of the intestines.

Santonica.—Santonica. The unexpanded flowers of *Artemisia pauciflora* Weber (Nat. Ord. *Compositæ*). (U. S. P.) *Semencine*, Fr.; *Wurmsamen*, Ger.

Composition.—Resin, malic acid, essential oil, and a crystallizable principle (*santonin*).

Santoninum.—Santonin. A neutral principle obtained from santonica. A colorless substance, crystallizing in shining, flattened prisms, without smell, and nearly tasteless when first put into the mouth, and afterward bitter. It is not altered by the air, but becomes yellow on exposure to light. Nearly insoluble in cold water, it is dissolved by two hundred and fifty parts of boiling water. It is soluble in forty-three parts of cold or in three parts of boiling alcohol, and in seventy-five parts of ether. Dose, gr. ss—gr. v, according to age.

Trochisci Santonini.—Troches of santonin. (Santonin, 3 grm.; with sugar, tragacanth, orange-flower water, to form one hundred troches.) Each troche contains a half-grain of santonin, and from one to three are sufficient as a vermifuge in children.

Antagonists and Incompatibles.—We do not possess any satisfactory data in regard to the physiological antagonists of santonin. When a poisonous dose has been taken the stomach should be emptied, and the systemic effects should be treated symptomatically.

Synergists.—Therapeutically the action of santonin is aided by cathartics, especially by calomel.

Physiological Actions.—In ordinary medicinal doses as used for the expulsion of lumbrici, santonin causes no sensible intestinal disturbance. In considerable doses nausea and vomiting are produced, and are followed by colic and diarrhœa. Santonin enters the blood, probably, in combination with soda, for, although it has no acid properties, it has the power to form such combinations. Santonin, according to Hesse (Flückiger and Hanbury), is the anhydride of a crystallizable acid, which, when heated, is resolved into santonin and water. Vision is affected in a remarkable manner. Usually all objects appear as if viewed through yellow glass; but other colors sometimes appear, as green, blue, or even red (*Gelbsehen*, Rose). The chromatopsia is probably due, according to Rose, to the solution of santonin in the alkaline serum, and its action on the perceptive centers (vol. xviii, page 26). In passing out with the urine santonin imparts a yellowish, and, when the amount is large, a reddish-purple, hue to this fluid.

In toxic doses santonin produces very decided cerebral effects: trembling, vertigo, convulsive movements, tetanoid cramps, stupor, cold sweats, dilated pupils, insensibility, etc.

Therapy.—Cures of *amaurosis* have been reported from the use of santonin, but we possess no exact indications for its administration. It is, probably, effective only in functional derangement. The chief use of this remedy is for the expulsion of *ascarides lumbricoides*. It is the most effective and pleasant remedy which can be employed for this purpose. A convenient form for administration is the troche, or it may be prescribed in a powder with calomel. The following is a successful plan of using this parasiticide: A laxative in the morning, fasting through the day, a dose of santonin and calomel at bedtime, a senna-draught on the following morning.

Authorities referred to :

Brown, Dr. Dyce. *Schmidt's Jahrbücher*, vol. cl, p. 138.
Flückiger and Hanbury. *Pharmacographia*, p. 347.
Hermann, Dr. L. *Lehrbuch der exper. Toxikologie*, p. 383.
Husemann, Drs. Aug. und Theod. *Die Pflanzenstoffe*, p. 927.
Köhler, Prof. Dr. Hermann. *Handbuch*, vol. ii, p. 1292.
Rose, E. *Virchow's Archiv*, vols. xvi, xviii, xix, xx, xxviii.

Spigelia.—Pink-root. The rhizoma and roots of *Spigelia marilandica* Linné (Nat. Ord. *Loganiaceæ*).

Extractum Spigeliæ Fluidum.—Fluid extract of spigelia. Dose, ʒj—℥ss.

Composition.—A bitter, uncrystallizable principle (*spigelin ?*), volatile oil, tannic and gallic acid.

Actions and Uses.—In moderate doses spigelia produces a sensation of warmth at the epigastrium, stimulates the intestinal movements, accelerates the action of the heart, and promotes the cutaneous transpiration. In large doses it causes cerebral effects, vertigo, dimness of vision, dilated pupils, convulsions, and insensibility. Many of the serious symptoms supposed to have been produced by it in certain cases were probably really due to pre-existing cerebral lesions. Cases of basilar meningitis, for example, have not unfrequently been confounded with "worm-fever." Any vermifuge, given under these circumstances, might seem to have caused the head-symptoms which are characteristic of the brain-lesions.

Spigelia is used only as a vermifuge, and against the *round worm*, for the expulsion of which it has proved to be very efficient. A low diet and a brisk cathartic should precede the use of this remedy. The best form for administration is the fluid extract of senna and spigelia.

Authorities referred to :

Porcher, Dr. F. P. *Resources of the Southern Fields and Forests.*
Stillé, Dr. Alfred. *Therapeutics and Materia Medica.*

Chenopodium.—Worm-seed. The fruit of *Chenopodium anthelminticum* Linné (Nat. Ord. *Chenopodiaceæ*).

Oleum Chenopodii.—Oil of worm-seed. Dose, gtt. v—gtt. xv.

Actions and Uses.—The oil of worm-seed is the only preparation of the plant now used, and this is rarely employed, in consequence of its very disagreeable and characteristic odor and taste. It excites a sensation of warmth at the epigastrium, increases the action of the heart, and promotes cutaneous, bronchial, and renal secretions. It is a diffusible stimulant, and as such may be given with advantage in *hysteria* and *chorea*, as a carminative in *flatulence*, and as an antiperiodic in *intermittents*. The only use of worm-seed is as a remedy for ascarides lumbricoides. It is one of the most efficient of the class. It should be given three times a day for two days, and followed by a brisk cathartic. An excellent combination for the expulsion of the round worm is ten drops of worm-seed oil, and a teaspoonful of fluid extract of senna and spigelia. It may also be administered in castor-oil.

REMEDIES USED AGAINST TÆNIÆ.

The success of tæniafuges depends largely upon the preliminary treatment. The parasite is imbedded in mucus, its hooklets fixed in the mucous membrane. The medicament which is administered for its expulsion must come in contact with the scolex. To dislodge a quantity, however large, of the segments (*strobila*), although temporary relief may follow, will not be permanently curative. The head of the parasite must be expelled.

Before using the tæniafuge the contents of the intestinal canal must be thoroughly evacuated.

Two days of fasting, some milk and bread only being taken, must precede the treatment.

Aspidium.—Male fern. The rhizoma of *Dryopteris filix-mas* Schott, and of *Dryopteris marginalis* Asa Gray (Nat. Ord. *Filices*). (U. S. P.) *Fougère mâle*, Fr.; *Wurmfarnwurzel*, Ger.

Oleo-resina Aspidii.—Oleo-resin of fern. Dose, ʒ ss— ʒ ij.

Composition.—A green, fatty oil, volatile oil, resin, tannin, etc. The ethereal extract deposits a granular, crystalline substance (*filicic acid*), on which the medicinal activity of the drug appears to depend.

Actions and Uses.—The oleo-resin of filix mas is a very efficient remedy for tape-worm, especially the unarmed variety; but, if suitable precautions be taken to insure success, it is quite a certain remedy for the armed tænia. The method of Trousseaux and Pidoux is as efficient as any (vol. ii, page 1040). On the first day, a strictly milk diet; on the morning of the second day, four grammes (about ʒ j) of the oleo-resin in four doses, with an interval of a quarter of an hour between each; on the third day, the same quantity at the same intervals, followed by fifty grammes of the sirup of ether, and, a half-hour later, an emulsion containing three drops of croton-oil. Kuchenmeister gives a number of methods, and Cobbold favors the employment of male fern in certain cases.

Granatum.—Pomegranate. The bark of the stem and root of *Punica granatum* Linné (Nat. Ord. *Lythraricæ*). (U. S. P.) *Écorce de racine de grenadier*, Fr.; *Granatwurzelrinde*, Ger.

Composition.—Pomegranate-bark contains a principle—*pelleterine*—on which its activity depends. The tannate, an efficient tæniafuge, can be given in doses of five grains to one scruple.

Actions and Uses.—The rind of the fresh root only should be used.

The best preparation is the decoction, prepared by boiling gently two ounces of the bark in a quart of water down to a pint. Of this decoction a wineglassful may be given every hour until all is taken. It should be preceded by a brisk purgative, and should be taken fasting. It produces more or less nausea, borborygmi, intestinal pain, and usually purges. If a purgative effect is not caused by it, a brisk cathartic should follow. In the author's experience, this is a very certain and efficient tæniafuge. Tanret's preparation of unpurified pelleterine, in solution, has acted very efficiently in some cases.

Cusso.—Kousso. The female inflorescence of *Hagenia abyssinica* Bruce (Nat. Ord. *Rosaceæ*). (U. S. P.) *Brayère anthelminthique*, Fr.; *Kussoblüthen*, Ger.

Extractum Cusso Fluidum.—Fluid extract of cusso. Dose, ʒ ij —℥ j.

Infusum Brayeræ.—Infusion of cusso (six parts to one hundred of water). Dose, ℥ iv—℥ viij—Oj, or more. (Not official.)

Composition.—Brayera contains an active principle (*kosin*, or *koussin*), which crystallizes in rhombic prisms. Kosin appears to be inert of itself, and is active only when combined with the other constituents of the drug.

Actions and Uses.—Kousso is used solely as an anthelmintic. Opinions vary as to its utility. On the whole, it may be said that the first enthusiasm which attended its introduction into practice has died away. It brings the segments, but rarely expels the head of the parasite. It is necessary to take it in large quantity—half an ounce—mixed with water. It is retained with difficulty, and produces much intestinal distress. When successful, the worm is brought away without the action of a purgative.

Kamala.—Kamala. The glands and hairs from the capsules of *Mallotus Philippinensis* Mueller Arg. (Nat. Ord. *Euphorbiaceæ*). (U. S. P.) Dose, ʒ j—ʒ iij.

There are no official preparations. A saturated tincture may be given, in the dose of one to three drachms.

Actions and Uses.—It is an orange powder. It causes some nausea and griping, usually, but it may operate without producing any unpleasant sensations. It acts as a purgative, and causes the expulsion of the worm. If one dose is insufficient, its administration should be continued every three hours until five or six doses have been taken. Kamala is effective not only against tape-worm, but also against lumbrici and ascarides vermiculares.

Pepo.—Pumpkin-seed. The seed of *Cucurbito pepo* Linné (Nat. Ord. *Cucurbitaceæ*).

Actions and Uses.—This is one of the most efficient remedies which we possess against tænia. Two ounces of the fresh seed are pounded in a mortar, with a half-pint of water, until the husks are loosened and an emulsion is made. The mixture is then strained, and the whole amount is taken fasting; but Squibb maintains that all should be taken, husks included. If an action of the bowels does not take place in two hours, the emulsion should be followed by castor-oil. If success is not attained, the dose may be repeated each morning until the parasite is produced. Numerous cases of successful use of pumpkin-seed emulsion have been reported.

The expressed oil, which is bland and unirritating, like almond-oil, may be used as a substitute for the seeds. It should be given in the dose of a half-ounce, two or more times, and after several hours followed by castor-oil. The rules already given, in regard to preliminary treatment, should also be followed.

Authorities referred to:

COBBOLD, T. SPENCER. *On Parasites.* Also various articles in *The Medical Times and Gazette*, 1875.

HUSEMANN, DR. THEODOR. *Handbuch*, *op. cit.*, erster Band, p. 202.

KÖHLER, DR. HERMANN. *Handbuch der physiologische Therapeutik*, zweiter Band, p. 1292.

KÜCHENMEISTER, DR. FREDERICK. *On Animal and Vegetable Parasites*, Sydenham Society, vol. i, p. 147, *et seq.*

STILLÉ, DR. ALFRED. *Therapeutics and Materia Medica*, vol. ii.

SQUIBB, DR. EDWARD. *The Ephemeris*, 1883.

THESE remedies are employed chiefly for their action on the genito-urinary passages. They stimulate the kidneys to increased activity, and excite the functions of the pelvic viscera. In excessive quantity, or long continued, they may set up inflammation of the kidney, produce strangury and bloody urine, excite uterine contractions, and stimulate to an unnatural degree the sexual propensities. They contain an essential oil, or principle, which makes its exit by the urinary passages and excites local irritation by direct contact.

Terebinthina.—Turpentine. A concrete oleo-resin obtained from *Pinus palustris* Miller, and from other species of *Pinus* (Nat. Ord. *Coniferæ*).

Oleum Terebinthinæ.—Oil of turpentine. A volatile oil distilled from turpentine. (U. S. P.) *Essence de térébinthine*, Fr.; *Terpentinöl*, Ger. Dose, ♏ v— ℥ ss.

Linimentum Terebinthinæ.—Liniment of turpentine. (Resin cerate, sixty-five parts; oil of turpentine, thirty-five parts.)

Oleum Terebinthinæ Rectificatum.—Rectified oil of turpentine. Dose, ♏ j—♏ xxx. This should be dispensed on prescription.

Antagonists and Incompatibles.—All remedies increasing waste, and the vaso-motor depressants, counterbalance the therapeutical actions of turpentine. In cases of poisoning the stomach should be promptly emptied, and anodynes and demulcents should be administered. Elimination should be favored, and the toxic symptoms treated according to the systemic indications. Ozonized oil of turpentine is an antidote to phosphorus, preventing the formation of phosphoric acid and converting the poison into an insoluble spermaceti-like substance. Turpentine worn in a vial about the neck prevents necrosis of the jaw and steatosis of organs in workmen engaged in manufactures employing phosphorus.

Synergists.—The diffusible and alcoholic stimulants favor the action of turpentine.

Physiological Actions.—Turpentine-oil is a limpid, colorless fluid, having a strong, peculiar, and diffusive odor, and a hot and pungent taste. It is very slightly soluble in water. The oil exposed to the air absorbs oxygen (ozone), which it retains with great tenacity. Applied to the skin, turpentine causes heat, redness followed by a vesicular eruption, and sometimes by intractable ulcerations. A few drops produce a sense of heat at the epigastrium, and a large dose (medicinal) causes intense burning pain, nausea, eructations of the oil, intestinal irritation and purging (usually). Notwithstanding its slight solubility in water, turpentine diffuses into the blood with facility, and is quickly recognized in the breath, sweat, and urine. The action of the heart and arteries is increased by it, the arterial tension rises, and a general sense of warmth and exhilaration is experienced. In large doses (one or two ounces) vomiting, thirst, and a febrile state, are induced ; the muscular strength is diminished, the power of co-ordination is impaired ; exhilaration of mind, incoherence of ideas, and rambling insensibility, follow. In toxic doses there are complete muscular relaxation and profound insensibility with abolition of all reflex movements ; the face is flushed or cyanosed, the pupils usually dilated, and the breathing labored and stertorous. All the organs by which turpentine is eliminated, especially the kidneys, suffer from extreme irritation when large doses have been swallowed. The skin is usually moist, and exhales a turpentine-odor ; the bronchial secretion is increased, and convulsive coughing is induced ; the urine is scanty and bloody, and there is violent strangury. The only fatal cases which have been reported have occurred in children (Taylor). From four to six ounces have not destroyed life in adults.

As regards its action on the organs of circulation, the author's experiments show that turpentine stimulates the vaso-motor nervous system when administered in moderate doses. A large quantity quickly exhausts the irritability of the sympathetic ganglia, the action of the heart becomes weak, and the arterial tension falls ; the respiratory movements are at first stimulated, but afterward become shallow, and carbonic-acid poisoning supervenes. The brains of animals killed by turpentine smell strongly of it, and hence it may be concluded that it has a direct action on the cells of the cerebral lobes.

Turpentine has decided antiseptic power. It arrests fermentation processes, putrefaction, and is very destructive of minute organisms (vibrio, bacteria, etc.).

The vapor of turpentine inhaled produces nasal and bronchial irritation, frontal headache, and renal irritation, even bloody urine and strangury.

On *post mortem* after turpentine-poisoning, violent gastro-intestinal irritation, ecchymoses of the air-passages, congestion of the lungs, and hyperæmia of the kidneys, are noted.

THERAPY.—*Flatulence* may be quickly relieved by a few drops (three to five) of turpentine, on a lump of sugar. This remedy is especially indicated in flatulence persisting from a paretic state of the muscular layer of the bowel. There is abundant evidence to prove the curative power of oil of turpentine in *chronic intestinal catarrh.* It is especially indicated when the tongue is dry and glazed, when there is tympanitic distention of the bowels, and when the alvine discharges consist either of fluid fæces or scybala, mixed with mucus and pale, watery blood. It is best administered in an emulsion, with almond-oil and opium. ℞ Ol. terebinthini, ʒ j; ol. amygdal. express., ℥ ss; tinct. opii, ʒ ij; mucil. acaciæ, ʒ v; aquæ laur.-cerasi, ℥ ss. M. Sig.: *A teaspoonful every three, four, or six hours.* The same remedy, in a similar combination, is very effective in acute dysentery after the subsidence of the more acute symptoms. The following is probably the true explanation of its action in these cases: it gives tonicity to the vessels, and to the muscular fiber of the intestines; arrests the putrefactive and fermentative processes which take place in the vitiated mucus and articles of food, and increases the cutaneous capillary circulation, thus relieving congestion of internal organs.

Stimulating enemata are made of turpentine, mucilage, oils, etc. These are especially indicated in constipation, and in impaction of the rectum. ℞ Ol. terebinthini, ʒ ij—℥ j; ol. ricini, ℥ ij; vitell. ovi unius; decoct. hordei, ℥ viij—Oj. M. Sig.: *As an enema.* Such injections are frequently used in tympanitic distention of the large intestine, in flatulent colic, in impaction of the cæcum, etc.

A combination of equal parts of turpentine and ether constitutes the well-known remedy of Durand for the solution and cure of *biliary calculi.* Notwithstanding the unquestionable utility of this remedy, we can not admit with Durand that its efficacy depends on its solvent power (Trousseau). During the attack of biliary colic this remedy may be administered with a view to its anodyne and antispasmodic effect; but, as Köhler states, it is by no means equal to morphine and chloral hydrate. In the after-treatment, clinical experience is in favor of the occasional administration of Durand's remedy during a course of Vichy or Carlsbad water.

Turpentine is one of the most effective remedies which we possess in the treatment of *tæniæ*. Full doses (℥ ss—℥ ij) are required, and the rules for preliminary treatment already laid down (see ANTHELMINTICS) should be adhered to. Turpentine should be combined with a purgative, in order to insure prompt cathartic effect. If absorption of any considerable part of the turpentine takes place, violent intoxication will follow, and irritation of the kidneys, hæmaturia, and strangury, will be produced in the efforts at elimination. The oleo-resin of *filix mas* may be combined with turpentine. ℞ Ol. terebinthinæ, ℥ j; oleo-resinæ filicis, ʒ j; vitell. ovi no. ij; ol. ricini, ℥ j. M. Sig.: *A draught.* This is an effective, but by no means an agreeable, mixture. An ounce each of turpentine and castor-oil may be administered, as the cathartic, after the use of the decoction of pomegranate.

Turpentine being a cardiac stimulant, and an excitant of the capillary circulation, is contraindicated in hypertrophy of the heart, and when advanced atheroma of the cerebral arteries may be presumed to exist. It is a serviceable *cardiac stimulant* when the action of the heart is weak, and the arterial tension low. In the *passive hæmorrhages* we possess few agents more generally useful. The indications for its use are a condition of debility, relaxation of the vessels, and an impoverished condition of the blood. Transudations on the free mucous surfaces—*epistaxis, bronchial hæmorrhage, hæmatemesis, intestinal hæmorrhages, hæmaturia*—when associated with the state of constitutional depression defined above, are forms of hæmorrhage in which turpentine should be used. ℞ Ol. terebinthinæ, ʒ iij; ext. digitalis fl., ʒ j; mucil. acaciæ, ℥ ss; aquæ menthæ pip., ℥ j. M. Sig.: *A teaspoonful every three hours.* The hæmorrhagic transudations which take place in *purpura*, in *scorbutus*, and allied states, are also arrested by turpentine. It need hardly be stated that active hæmorrhage and a condition of plethora contraindicate the use of turpentine.

As a stimulant to the vaso-motor nervous system, turpentine is indicated in *fevers* when the action of the heart is feeble, the arterial tension low, and the peripheral circulation languid. Ten drops in an emulsion is a suitable form, and every two hours is a proper interval for its administration in this condition of things. According to G. B. Wood, a dry tongue, peeling off in flakes, leaving a glazed surface beneath, is a special indication for the use of turpentine in fevers. The intestinal hæmorrhage of typhoid may be restrained by turpentine.

Clinical experience is in favor of the use of turpentine in *puerperal fever* and in *yellow fever*. The indications for its employment in these maladies are just the same as those mentioned above in typhoid. Cardiac weakness, depression of the vaso-motor nervous system, a dissolved state of the blood, are the conditions requiring turpentine. Tympanitic distention of the abdomen is an additional indication in puerperal fever. Similarly, turpentine is used in *epidemic dysentery, traumatic erysipelas, hospital gangrene*, etc. In these various states, employed with a well-defined conception of its real powers, this remedy is more generally serviceable as a stimulant than alcohol. As respects the dosage, in febrile diseases, a rule may be formulated as follows: for the intestinal complications, small doses frequently repeated (ten drops); as a stimulant to the vaso-motor nervous system, larger doses (♏ x—ʒ ss) at somewhat longer intervals.

In the article on "PHOSPHORUS" attention has been called to the utility of turpentine in poisoning by this substance.

The physiological effects of turpentine indicate its utility in certain disorders of the nervous system. As an enema, turpentine has been used for its derivative effect in *insolation* or *sunstroke* (Levick, Wood), and in *cerebro-spinal meningitis* (Hirsch). So accurate an authority as Topinard maintains the utility of this remedy in the cystic complications of *posterior spinal sclerosis*. Turpentine has long been used successfully in *epilepsy*, but in those cases only in which the seizures were due to the reflex impression of intestinal parasites (tæniæ). *Tic-douloureux* and *sciatica*, when rheumatic in origin, or when produced by fecal accumulations, have been cured by the vigorous use of turpentine, but we have now other means of treatment more generally useful and less disagreeable.

As turpentine is largely eliminated by the bronchial and renal mucous membrane, decided effects are produced at these points. In diffusing outward, a change in the tonicity of the vessels, and in the character of the secretions, must necessarily be produced. Clinical experience confirms the deductions of theory. In *chronic bronchitis*, with profuse expectoration (bronchorrhœa), especially when the expectorated matters have a fetid odor, turpentine is an excellent remedy (Oppolzer). In *gangrene of the lung*, although it is not curative, it acts beneficially in diminishing the fetor. In *pneumonia* and *capillary bronchitis*, when the vital powers are depressed and the peripheral circulation is feeble, turpentine is one of the best stimulants which we can employ. The depression which occurs during the period of crisis in pneumonia, and the condition of purulent infiltration, especially indicate the use of this remedy. In the so-called *humid asthma*, and in *emphysema* with profuse bronchial catarrh, good results are obtained by the use of turpentine. In these various pulmonary maladies, the action of turpentine is largely local, as already explained, but it should not be forgotten that the powerful stimulation of the cutaneous circulation which it causes must contribute no small share of the curative action.

In *hydro-nephrosis* and *pyo-nephrosis* turpentine is used as in bronchial catarrh, viz., to alter by actual contact the relaxed condition of the vessels, and the pathological secretions of the mucous membrane. It is, of course, contraindicated during the existence of acute symptoms. *Chronic catarrh of the bladder* is not unfrequently much improved by the use of this agent. It is most serviceable in those cases resulting from a transference of urethral inflammation, or due to prostatic disease. *Incontinence of urine*, the result of atony of the muscular layer of the bladder, is sometimes removed by small doses of turpentine. *Chronic gonorrhœa, gleet, spermatorrhœa*, and *prostorrhœa*, when the discharges peculiar to these maladies are due to a relaxed condition of the affected parts, are not unfrequently remarkably benefited by moderate doses of turpentine.

EXTERNAL USES OF TURPENTINE.—The author long ago pointed out the fact that turpentine is one of the most efficient applications in *hospital gangrene*. The mortified parts are first removed with the scissors, and the remedy is then applied directly to the affected surface, by means of a piece of cotton cloth saturated with it. Fetor is removed and sloughing is arrested, and but little pain attends the application.

Turpentine-stupes are much employed as a local and external means of treating internal inflammations. A piece of spongio-piline, or of flannel, large enough to cover the affected part, is first moistened with hot water, and then a few drops of turpentine (five to ten drops only) are sprinkled on it. As very severe smarting, inflammation, and vesication of the skin may occur from the application, and be experienced, indeed, some time subsequently to the removal of the stupe, care must be used not to continue it too long.

Liniment of turpentine is a convenient counter-irritant in cases of *myalgia, superficial neuralgia, lumbago*, etc. An excellent counter-irritant application is made by mixing equal parts of oil of turpentine, acetic acid, and liniment of camphor (Stillé). The most successful treatment of severe *burns* is by the plan of Kentish, which consists in first washing the injured surface with turpentine, and then applying an ointment made by mixing basilicon-ointment with turpentine. *Erysipelas* has been treated by the same measures by Meigs, and the same applications are generally in use in *chilblains*.

Inhalations of turpentine-vapor, or atomized turpentine, is an efficient means of local treatment in *chronic laryngeal and bronchial affections*. As a matter of curious therapeutics, it may be mentioned that gonorrhœa has been successfully treated by having the patient inhale the vapor of turpentine in an apartment filled with it.

Terebenum.—Terebene. A colorless or slightly yellowish thin liquid, having a rather agreeable thyme-like odor, and an aromatic taste. Only slightly soluble in water, but soluble in an equal volume of alcohol. Dose, ♏v—ʒ ss.

Terpini Hydras.—Terpin hydrate. Colorless, lustrous, rhombic prisms, nearly odorless, and having a slight aromatic and somewhat bitter taste. Soluble at 59° Fahr. in about 250 parts of water and in 10 parts of alcohol. Dose, gr. ss—gr. v.

By the distillation of turpentine with an alkali, a hydrocarbon ($C_{10}H_{16}$), which is now designated by our French colleagues by the name *terebinthine*, is produced. This is converted by hydration into a solid crystalline body—*terpine.* When terpine is acted on by an acid it is converted into *terpinol*, so named because it has an oily appearance and consistence. Terebene, as known to English-speaking therapeutists, is derived from turpentine by the action of an acid (sulphuric).

The dose of the hydrate of terpin is from five to twenty grains. Terebene is given in from five to twenty minims. They are but feebly soluble in water, and require alcohol to effect a solution. They can be made into an emulsion, or dropped on a lump of sugar, or put into gelatine capsules. To obtain the best effects of which they are capable, maximum doses are necessary. Their most important uses, also, are in the treatment of affections of the mucous membranes—of *bronchitis*, *emphysema*, *capillary bronchitis* or *broncho-pneumonia*, *asthma*, etc. These therapeutical results are for the most part due to the local action at the points of elimination—bronchial and renal. The same action, therefore, occurs in pyo-nephritis and in the catarrhal process affecting the bladder. Dujardin-Beaumetz, in arranging these medicaments in the order of their relative utility, places them thus: in bronchial affections, terpinol or terebene is first, but in renal affections terebinthene or terpine.

Given in full medicinal doses these remedies cause a feeling of warmth in the epigastric region, and, if no local irritation exists, rather stimulate appetite and digestion than impair them. They possess carminative properties, and cause the expulsion of gases. Secretion is increased and the peristaltic movements are also somewhat accelerated. In respect to these actions, these remedies have properties corresponding to those of turpentine. When the tongue is dry and exfoliates in large flakes, the terebinthinate preparations act favorably. When intestinal hæmorrhage takes the form of oozing from a large surface, the general condition being one of debility, and the blood impoverished, terebinthene will no doubt act favorably.

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Copaiba.—Copaiba. The oleo-resin of *Copaiba Langsdorfii* Desfontaines, and of other species of *Copaifera* (Nat. Ord. *Leguminosæ*, *Papilionaceæ*). *Baume de copahu*, Fr.; *Copaiva-Balsam*, Ger. Dose, ♏ x—ʒ j.

Massa Copaibæ.—Mass of copaiba. (Copaiba, 94 grm.; magnesia, 6 grm.)

Oleum Copaibæ.—Oil of copaiba. A volatile oil distilled from copaiba. Dose, ♏ v—ʒ ss.

Resina Copaibæ.—Resin of copaiba. The residue left after distilling off the volatile oil from copaiba. Dose, gr. j—gr. v.

Composition.—Balsam of copaiba differs from the true balsams in not containing cinnamic acid. It is an oleo-resin, the volatile oil constituting from forty to sixty per cent. The oil of copaiba is isomeric with the oil of turpentine, but it differs in some of its physical properties from the latter. The resin has an acid reaction, and has been entitled *copaivic acid.*

Actions and Uses.—Copaiba has a nauseous, bitter, and very disagreeable taste. When taken into the stomach it causes some heat, and offensive eructations, tasting of the balsam, occur. Indigestion, heaviness at the epigastrium, anorexia, are frequently produced by it, and diarrhœa is an occasional result of its use. It is, therefore, a gastro-intestinal irritant. Both the oil and the resin diffuse into the blood. The various excretions, the sweat, the bronchial mucus, the urine, acquire a peculiar and rather a fragrant odor from its presence. This odor is especially observable in the urine, and in this secretion the resin may be discovered also by the addition of nitric acid, which causes a precipitate. At the points of elimination more or less irritation is produced, and, as a result of the irritation, increased secretion; hence copaiba is said to be diaphoretic, diuretic, and expectorant. Very serious injury may be done to the gastro-intestinal canal, and to the kidneys, by the use of this agent in large doses. The author has known gastro-intestinal catarrh to persist many months after a course of copaiba, and he has reason to believe that desquamative nephritis and fibroid kidney have resulted from its free administration for a lengthened period. While small doses of balsam will increase the gross amount of urine and of the solid contents, large doses will actually cause a diminution in the amount both of water and solids by setting up renal irritation. Although, during a course of balsam, nitric acid causes a precipitation of the resin, which is dissolved on the addition of alcohol, the author has, in several instances at least, detected albumen in the urine of those taking this remedy.

Copaiba is contraindicated when a condition of gastro-intestinal irritation and hyperæmia of the kidneys exist.

Gonorrhœa is the disease to which copaiba is most especially adapted. Its administration should not be begun, however, until after the acuter symptoms have subsided. As the action of the remedy is local or direct, acute symptoms are rather aggravated by it. Combination with liquor potassæ promotes its curative action by diminishing the acidity, and hence the irritation produced by the urine. Combination with agents acting synergistically, as oils of cubebs and sandalwood, is also desirable. The following formulæ exemplify these therapeutical facts: ℞ Copaibæ, pulv. cubebæ, āā ℥ ij; aluminis, ℥ j; opii, gr. v. M. Sig.: *One to two drachms, night and morning.* ℞ Ol. copaibæ, ol. cubebæ, ol. santal. flav., āā ʒ j; magnesiæ, ʒ ij. M. Ft. pil. no. lx. Sig.: *Two pills every four hours.*

In *chronic catarrh of the bladder*, copaiba is useful by virtue of the local action which it has upon the mucous membrane. Its nauseous taste and the gastric and renal irritation produced by it are serious objections to its use in a malady which requires the persistent and long-continued application of remedies in order to even moderate its symptoms.

For *acute bronchitis* after the subsidence of the fever, for *chronic bronchitis* with profuse secretion, for *bronchorrhœa* (dilated bronchi), copaiba is the most generally serviceable expectorant. Unfortunately, it is so disagreeable that it is difficult to overcome the repugnance of patients. Even when administered in capsules, or in pill-form with magnesia, the nauseous eructations excite disgust. ℞ Copaibæ, balsam. tolutan., pulv. acaciæ, āā ℥ ss; acid. sulphur. aromat., ʒ ss; aquæ destil., ℥ vj. M. Sig.: *A tablespoonful, two or three times a day, in chronic bronchial affections, whooping-cough,* etc. ℞ Copaibæ; syrp. tolutan., āā ℥ ss; aquæ menthæ pip., ℥ ij; spirit. etheris nitrosi, ℥ j. M. Sig.: *A teaspoonful every four hours.*

Excellent results have been obtained from the use of copaiba in *dropsy*, especially in *ascites*. In these cases it acts powerfully on the kidneys. Wilks holds that copaiba-resin is a more efficient diuretic than the balsam. ℞ Res. copaibæ, ʒ iij; alcohol., ʒ v; spirit. chloroformi, ʒ j; mucil. acaciæ, ℥ ij; aquæ ad ℥ xij. M. Sig.: *A tablespoonful ter in die.* It is conveniently given in pill-form also.

In some subjects possessed of an irritable skin, copaiba produces an eruption of urticaria, or roseola, or erythema. This is not in consequence of a selective action on the skin, but is the result merely of the gastro-intestinal disturbance. Influenced, probably, by this fact that an eruption may be caused by copaiba, this agent has been proposed as a remedy in certain *cutaneous diseases*—in those characterized by torpor of the peripheral circulation.

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Cubeba.—Cubeb. The unripe fruit of *Piper Cubeba* Linné *filices* (Nat. Ord. *Piperaceæ*). (U. S. P.) *Cubèbes*, Fr. ; *Cubeben*, Ger.

Extractum Cubebæ Fluidum.—Fluid extract of cubeb. Dose, ʒ ss — ʒ ij.

Oleum Cubebæ.—Oil of cubeb. Dose, ♏ v — ʒ ss.

Oleo-resina Cubebæ.—Oleo-resin of cubeb. Dose, ♏ v — ʒ ss.

Tinctura Cubebæ.—Tincture of cubeb. Dose, ʒ ss— ʒ ij.

Trochisci Cubebæ.—Troches of cubeb.

Composition.—Cubeb contains a volatile oil which varies in proportion from six to fifteen per cent. It is polymeric with oil of turpentine. This volatile oil separates in the cold into two distinct substances —a camphoraceous substance (*cubebene*), and a liquid portion (*cubeben*). Besides these, a neutral crystallizable principle (*cubebin*) has been isolated. Cubeb also contains a resin, divisible into two distinct substances, an indifferent portion and an acid (*cubebic acid*). The therapeutical properties of the drug reside chiefly, if not exclusively, in the oil and resin, hence the oleo-resin is an efficient preparation.

Actions and Uses.—The taste of cubeb is aromatic, pungent, and somewhat camphoraceous. In the stomach it excites a sensation of warmth, and, in moderate doses, promotes the appetite and the digestive capacity. In considerable doses it is laxative, and produces a feeling of heat and irritation about the rectum. Ingested in a large quantity, cubeb sets up a gastro-intestinal catarrh, and may even cause acute inflammatory symptoms. The active principles diffuse into the blood. The action of the heart and vascular system is increased by cubeb, the surface becomes warm and perspiring under its use, and the bronchial and urinary secretions are more abundant. The odor of cubeb is imparted to the breath and to the urine, and the resin may be precipitated from the urine by the addition of nitric acid. As explained in the previous article (Copaiba), the resin precipitated by nitric acid resembles albumen, but differs from the latter substance in being soluble in alcohol.

Cubeb stimulates the venereal appetite in man, and promotes the catamenial flux in women.

Finely-powdered cubeb is an efficient local application in *chronic nasal catarrh*. It is blown into the nares by an insufflator. It gives considerable relief also in *hay-asthma*, when there is no fever, and the secretion of the nasal mucous membrane is profuse and watery. Powdered cubeb is useful as a topical application when the mucous membrane of the fauces is relaxed, or the seat of chronic inflammation (*follicular pharyngitis*). The official cubeb-troches are employed by singers and public readers, to maintain the tonicity of the mucous membrane and to prevent or relieve hoarseness.

Cubeb may also be used, in small doses, to promote secretion and increase digestion in cases of *atonic dyspepsia*. *Chronic catarrh of the colon and rectum*, with a relaxed condition of the mucous membrane and of the inferior hæmorrhoidal vessels, may be removed by cubeb. Sometimes these cases take the form of a mucous dysentery.

The most important application of cubeb is in the treatment of *gonorrhœa*. Unlike copaiba, it may be administered with good effect during the acute stage. The best results are obtained from a mixture of the two agents. *Catarrh of the bladder*, *prostorrhœa*, *spermatorrhœa*, are maladies in which cubeb may be employed with more or less advantage. When the sexual appetite is weak, and the erections feeble, cubeb will sometimes, if the troubles are functional, remove them.

Irritability of the bladder, nervous or functional in character, especially as it occurs in women, is generally relieved by cubeb ; but cantharides is a more efficient remedy for this troublesome affection.

In *chronic bronchial affections*, with profuse expectoration, cubeb has a remedial effect similar to that possessed by copaiba, and is useful under the same conditions.

Piper.—Black pepper. The unripe berries of *Piper nigrum* Linné (Nat. Ord. *Piperaceæ*). (U. S. P.) *Poivre noir*, Fr. ; *Schwarzer Pfeffer*, Ger.

COMPOSITION.—Pepper contains a resin and an essential oil, and a neutral crystallizable principle (*piperin*).

Oleo-resina Piperis.—Oleo-resin of black pepper. This contains the active constituents of pepper, and is an eligible preparation. Dose, ♏ j—♏ v.

Piperinum.—*Piperin.* A proximate principle of feebly alkaloidal power, prepared from pepper, and occurring also in other plants of the natural order *Piperaceæ*. Colorless or pale yellowish, shining, four-sided prisms, permanent in the air, odorless and almost tasteless when first put in the stomach, but on prolonged contact producing a biting sensation. It has a neutral reaction, is almost insoluble in water, but soluble in thirty parts of alcohol at 60° Fahr. Dose, gr. j—gr. x.

Capsicum.—Capsicum. The fruit of *Capsicum fastigiatum* Blume (Nat. Ord. *Solanaceæ*). (U. S. P.) *Poivre d'Inde*, Fr.; *Spanischer Pfeffer*, Ger.

Composition.—The acrid, pungent qualities of capsicum are due to a peculiar substance (*capsicin*), a thick, yellowish-red liquid. Fellétar, whose observations have been confirmed by Flückiger, has isolated a volatile alkaloid having the odor of conine.

Extractum Capsici Fluidum.—Fluid extract of capsicum. Dose, ♏ v—ʒ j.

Oleo-resina Capsici.—Oleo-resin of capsicum. Dose, ♏ j—♏ v.

Tinctura Capsici.—Tincture of capsicum. Dose, ♏ x—ʒ j.

Actions and Uses.—Notwithstanding black and red pepper belong to different orders, they are closely related therapeutically and in their physiological actions. They may with propriety be considered together.

When applied to the skin, pepper excites redness, heat, and superficial inflammation. Red pepper, if in contact with the skin a sufficient length of time, will produce vesication. It also causes great irritation of the mucous membrane. It has a hot, pungent, and rather acrid taste, and increases the flow of saliva. In the stomach a sensation of warmth is produced by it, the secretions are more abundant, digestion is more active, and the appetite is promoted. In an excessive quantity gastritis may be produced. The intestinal secretions are no doubt increased, and the alvine evacuations rendered more easy and copious.

The action of the heart and arteries is increased by pepper, a subjective sensation of warmth is experienced throughout the system, and cutaneous transpiration becomes more abundant. Elimination takes place chiefly through the kidneys. The flow of urine is increased, micturition is more frequent, and more or less vesical tenesmus occurs. Decided aphrodisiac effects are produced by red pepper.

The tincture of capsicum may be usefully employed as a stomachic in *atonic dyspepsia.* It is especially indicated in the *dyspepsia of chronic alcoholism*, when there are present trembling and insomnia. *Flatulent colic* may be relieved by capsicum, especially when this disorder occurs in hysterical subjects. The author has seen excellent results from the use of this remedy in the dyspepsia and flatulence of hypochondriacal subjects, and of women at the climacteric period.

Capsicum is an excellent addition to beef-tea when this aliment is administered in *fevers*, and other low conditions of the system. The tincture may be employed under the same circumstances as a cardiac stimulant. Piperin has been used in *cholera* as a stimulant, local and general, and in low conditions of the system from any cause except gastro-intestinal inflammation. At one time it was much prescribed in *malarial fevers* as an adjunct to quinine chiefly, and antiperiodic powers were ascribed to it; but such views are no longer entertained.

The evidence is conclusive that capsicum quiets restlessness and induces sleep in *delirium tremens.* It may be administered mixed with beef-tea or other animal broths, or thirty grains made into a bolus, with sirup or honey, may be given. As capsicum belongs to the family *Solanaceæ*, and as Fellétar discovered in it a volatile alkaloid, a rational explanation is afforded of its action on the cerebrum. According to Ringer, the tincture of capsicum is the best substitute for the stimulant when an attempt is made to break the *alcohol-habit.* It is also very serviceable in the treatment of the *opium-habit.* The good effect of the remedy in these cases is in part due to its action as a stomachic stimulant, and partly, doubtless, to its cerebral effects.

The oleo-resins of black and red pepper have been used with good results in the treatment of *intermittent fever.* They are useful chiefly as adjuvants to more efficient remedies.

Capsicum is contraindicated in all acute affections of the genito-urinary apparatus. In *chronic parenchymatous nephritis* it checks the waste of albumen. In *chronic pyelitis, chronic cystitis,* and *prostorrhœa,* it has a beneficial effect ; but, although similar in action to, it is less efficient than, cubeb. Excellent results are often obtained from it in *functional impotence,* and in *spermatorrhœa* from deficient tone. In these genito-urinary maladies, the oleo-resin is the best preparation for administration. ℞ Oleo-resinæ capsici, ℈j ; ergotin (aq. ext.), ℈ ij. M. Ft. pil. no. xx. Sig.: *One three times a day.*

A capsicum-plaster is a mild *counter-irritant.* The infusion is employed as a gargle in *tonsillitis, diphtheria,* and *scarlet fever.* As it is a very irritating application, its use should be restricted to cases characterized by a low grade of action.

Juniperus.—Juniper. The fruit of *Juniperus communis* Linné (Nat. Ord. *Coniferæ*). (U. S. P.) *Baies de genièvre,* Fr. ; *Wachholderbeeren,* Ger.

Infusum Juniperi.—Infusion of juniper (℥j—Oj). Dose, ℥ss—℥ij. (Not official.)

Oleum Juniperi.—Oil of juniper. Dose, ♏ v—♏ xx.

Spiritus Juniperi Compositus.—Compound spirit of juniper. (Oil of juniper, 8 c. c. ; alcohol, 1,400 c. c. ; water, sufficient to make 2,000 c. c. ; oils of caraway and fennel, each 1 c. c. Dose, ℥ss—℥j.

Spiritus Juniperi.—Spirit of juniper. (Oil of juniper, 50 c. c. ; alcohol, 950 c. c.) Dose, ʒj—℥j.

Oleum Cadinum.—Oil of cade. A product of the dry distillation of the wood of *Juniperus oxycedrus.*

Composition.—Juniper contains a *volatile oil,* upon which its medicinal effects chiefly depend. A non-crystallizable principle (*juniperine*) exists in the berries in very small quantity.

Actions and Uses.—Juniper increases the appetite and digestion, but in overdoses will disorder the stomach. The volatile oil diffuses into the blood with facility. Increased action of the heart and of the arteries, a subjective sensation of warmth, diaphoresis, and diuresis, are produced by it.

The oil is eliminated by the kidneys chiefly, and imparts an odor of violets to the urine. It powerfully stimulates the renal functions, and in large doses causes strangury and bloody urine. It may set up a high degree of irritation of the kidneys, leading to suppression and uræmic intoxication. In common with the other remedies of this group, juniper excites the venereal appetite; in large doses may cause priapism, and in women promotes the menstrual flow.

The principal use of juniper is as a *diuretic*. It is contraindicated in acute affections of the kidneys. It is largely employed as a diuretic in *cardiac* and *renal dropsy*. The infusion is an excellent vehicle for the exhibition of saline diuretics in these affections. The oil of juniper acts similarly to, and is indicated under the same conditions as, turpentine in *chronic pyelitis*, *chronic cystitis*, *gleet*, *prostorrhœa*, etc. Diuretic effects may be obtained by inhalation of the vapor of the oil. For this purpose a few drops may be put into hot water, and the vapor be inhaled.

The *empyreumatic oil of juniper* (oleum cadinum), obtained by destructive distillation from *Juniperus oxycedrus*, is a thick, black liquid, similar in appearance to and smelling like common tar. It is much employed as a local application in *chronic eczema*, *impetigo*, *ichthyosis*, *psoriasis*, *acne rosacea*, etc. It is usually combined with German soft-soap. ℞ Alcoholis, saponis mollis, ol. cadini, āā ℥ j; ol. lavendulæ, ʒ jss. M. ℞ Ol. juniperis empy. (ol. cadini), saponis mollis, āā ℥ j; ol. lavend., ʒ ss. M. Sig.: *Ointment*. ℞ Ol. juniperis empy., ʒ j—℥ j; sevi, ℥ ss; adipis, ℥ j. M. Sig.: *Ointment*.

Pix Liquida.—Tar.

Oleum Picis Liquidæ.—A volatile oil distilled from tar.

Balsamum Tolutanum.—A balsam obtained from *Toluifera balsamum* Linné (Nat. Ord. *Leguminosæ*).

Syrupus Tolutanus.—Dose, ʒ ss—ʒ ij.

These preparations are employed internally for their stimulating expectorant qualities, and topically in various affections of the skin—notably those characterized by a chronic scaly quality and those given to itching.

The sirup of tolu has mildly expectorant effects, but is used chiefly as a vehicle for the more active remedies of this kind.

Tar-water and sirup of tar have long been used in the treatment of cough and chronic bronchial affections. The sirup may be prepared extemporaneously by adding the volatile oil to simple sirup.

Buchu.—Buchu. The leaves of *Barosma betulina* and of other species of *Barosma* (Nat. Ord. *Rutaceæ*). (U. S. P.) *Feuilles de bucco*, Fr.; *Bukublätter*, Ger.

Infusum Buchu.—Infusion of buchu (℥ j—Oj). Dose, ℥ ss—℥ ij. (Not official.)

Extractum Buchu Fluidum.—Fluid extract of buchu. Dose, ♏ x—ʒ j.

Composition.—Buchu contains a *volatile oil* in the proportion of about 1·5 per cent. This volatile oil consists of a crude oil and a camphor—barosma camphor. The latter has a nearly pure peppermint odor. The existence of *barosmin*, so called, is doubtful.

Uva Ursi.—Uva ursi. The leaves of *Arctostaphylos uva ursi* Sprengel (Nat. Ord. *Ericaceæ*). (U. S. P.) *Feuilles de busserole*, Fr.; *Bärentraubenblätter*, Ger.

Extractum Uvæ Ursi.—Extract of uva ursi. Dose, gr. j—gr. v.

Extractum Uvæ Ursi Fluidum.—Fluid extract of uva ursi. Dose, ʒ ss—ij.

Composition.—Uva ursi contains a bitter, neutral, crystallizable substance, *arbutin*; a very bitter amorphous principle, *ericolin*; and a tasteless, crystallizable, neutral principle, *ursone*. It is rich in gallic and tannic acids. Its therapeutical properties are due to these several constituents.

Pareira.—Pareira brava. The root of *Chondodendron tomentosum* Ruiz et Pavon (Nat. Ord. *Menispermaceæ*). (U. S. P.) *Racine de pareira-brava*, Fr.; *Grieswurzel*, Ger.

Infusum Pareiræ.—Infusion of pareira brava (℥ j—Oj). Dose, ℥ ss—℥ ij. (Not official.)

Extractum Pareiræ Fluidum.—Fluid extract of pareira. Dose, ʒ ss—℥ ij.

Composition.—It contains a principle, *buxin*, but it is not known whether this is the active ingredient.

Chimaphila.—Pipsissewa. The leaves of *Chimaphila umbellata* Nuttall (Nat. Ord. *Ericaceæ*).

Decoctum Chimaphilæ.—Decoction of chimaphila. Dose, ℥ ss—℥ ij. (Not official.)

Extractum Chimaphilæ Fluidum.—Fluid extract of chimaphila. Dose, ʒ ss—ʒ ij.

Composition.—Pipsissewa contains a crystallizable principle, *chimaphilin*, tannic acid, extractive matters, etc.

Scoparius.—Broom. The tops of *Cystisis scoparius* Linné (Nat. Ord. *Leguminosæ*). (U. S. P.) *Genêt à balais*, Fr.; *Pfriemenkraut*, Ger.

Composition.—Scoparius contains an indifferent or somewhat acid crystallizable principle, *scoparin*, and an oily, colorless, liquid alkaloid, *sparteine*. The latter has very decided basic qualities, and agrees with conine and nicotine in being constituted without oxygen. Its actions and uses as a cardiac remedy have been given elsewhere, in connection with remedies therapeutically cognate. Here *scoparius* as a diuretic comes under consideration.

Actions and Uses.—Buchu, uva ursi, pareira, pipsissewa, and scoparius, form a group of diuretics with properties in common. They are tonic, astringent diuretics. They promote appetite and digestion, and restrain intestinal movements, except pareira, which has rather a laxative action. Their active constituents diffuse into the blood and are eliminated by the kidneys. In passing over the genito-urinary tract these principles act topically upon the mucous membrane. As a rule they are actively diuretic; that is, they increase the amount of urinary water. Pipsissewa and scoparius are rather more actively diuretic than buchu and uva ursi, and hence are more useful in dropsy. By English physicians generally, and notably the late Dr. Pereira, scoparius is held in much esteem as a remedy for *dropsy*. It is adapted especially to the treatment of *cardiac dropsy*, and the general anasarca of *chronic parenchymatous nephritis*, but is inadmissible in acute affections of the kidney. Our indigenous remedy, pipsissewa, may be substituted for scoparius in the treatment of dropsy.

Buchu, uva ursi, and pareira, are more particularly useful in *chronic pyelitis*, *catarrh of the bladder*, *chronic gonorrhœa*, etc.; and of these the most efficient, probably, is buchu. The fluid extract is the most eligible form in which these remedies can be administered.

Carota.—Carrot-seed. The fruit of *Daucus carota*. The wild carrot. (Not official.)

The seeds of carrot have a hot, pungent, and bitter taste, due to a volatile oil which they contain, and to which their medicinal activity is due. As they impart their virtues to water, an infusion of the seeds is an eligible form in which to administer the remedy. Carrot-seeds act similarly to juniper, and produce diuresis, augment the menstrual flux, and cause aphrodisiac effects in the male.

Taraxacum.—Dandelion. The root, gathered in the autumn, of *Taraxacum officinale* Weber (Nat. Ord. *Compositæ*). (U. S. P.) *Pissenlit*, Fr.; *Löwenzahnwurzel*, Ger.

Extractum Taraxaci.—Extract of taraxacum. Dose, gr. v—℈j.

Infusum Taraxaci.—Infusion of taraxacum (℥ij—Oj). Dose, ℥ss—℥ij. (Not official.)

Extractum Taraxaci Fluidum.—Fluid extract of taraxacum. Dose, ʒj—℥j.

Composition.—According to Kromayer, taraxacum contains *taraxacine*, an amorphous, intensely bitter principle, and a crystalline substance, *taraxacerine*. Nothing is definitely known as to the action of these substances.

Actions and Uses.—Taraxacum possesses the properties of a simple bitter, in that it promotes the appetite and digestion. It has been long held, both popularly and professionally, to possess the power to promote the flow of bile. Recent investigations have demonstrated the inaccuracy of these opinions. It is a mild laxative, and as such, doubtless, may cause by reflex stimulation an emptying of the gall-bladder. It is a diuretic, although not a very active one. It is still prescribed as a laxative in *catarrhal jaundice*, in *ascites* from hepatic disease, and in *dyspepsia* and *indigestion* associated with torpor of the liver. By German physicians, muriate of ammonia and dandelion are frequently associated together in the treatment of the affections above named. Taraxacum is occasionally used as a diuretic in *dropsy*, but its utility is very limited.

The fluid extract of taraxacum is a good vehicle for the administration of such remedies as the muriate of ammonia and quinine, the taste of which it somewhat covers.

Scilla.—Squill. The bulb of *Urginea maritima* (Linné) Baker (Nat. Ord. *Liliaceæ*). (U. S. P.) *Ognon marin*, Fr.; *Meerzwiebel*, Ger.

Acetum Scillæ.—Vinegar of squill (℥ iv—Oij.) Dose, ♏ xx—ʒ j.

Syrupus Scillæ.—Sirup of squill. Dose, ʒ ss—ʒ j.

Syrupus Scillæ Compositus.—Compound sirup of squill. Hive-sirup. This preparation contains squill, senega, and tartar-emetic, the last named in the proportion of one grain to the ounce. Dose, ♏ v—ʒ j. This is a very active preparation, due chiefly to the tartar-emetic.

Extractum Scillæ Fluidum.—Fluid extract of squill. Dose, ♏ j—♏ v.

Tinctura Scillæ.—Tincture of squill. Dose, ♏ v—ʒ ss.

Composition.—The important constituent of squill is an acrid, bitter principle, *scillitin*, or skuleïn—which has not yet been isolated. According to Schroff, scillitin is a glucoside, and the active principle is an acrid, non-volatile substance (Flückiger and Hanbury).

Actions and Uses.—The taste of squill is bitter and somewhat acrid. It is an irritant to the mucous membrane, and excites nausea, vomiting, and purging, when introduced into the stomach in a sufficient dose. Very violent gastro-enteritis may be produced by its incautious administration in large doses. A state of hyperæmia or inflammation of the gastro-intestinal mucous membrane, therefore, contraindicates its use.

The active constituents of squill diffuse into the blood. Its systemic effects are produced by application to the external integument.

Paralysis and convulsions are induced in warm-blooded animals by toxic doses; and similar cerebral symptoms occur in man, in addition to the phenomena which usually attend the action of an irritant poison. In ordinary medicinal doses squill increases the bronchial mucus and facilitates expectoration. In toxic doses rapid breathing has usually occurred. It is highly probable that a portion of the active constituents of squill is eliminated by the broncho-pulmonary mucous membrane.

Squill stimulates the functions of the kidneys and increases the urinary discharge when used in medicinal doses, but in excessive quantity it excites violent inflammation, with strangury and bloody urine. Suppression of urine may be a result of its irritating action on the kidneys.

The use of squill is confined to its expectorant and diuretic effects. The *acetum* and *syrupus scillæ* enter into the composition of expectorant mixtures employed in the treatment of *catarrh of the bronchial tubes*, after the subsidence of acute symptoms, and the chronic forms of the disease. Squill is more particularly indicated when the sputa are tenacious, and are coughed up with difficulty. Ipecacuanha is advantageously combined with it in the more recent cases. ℞ Acet. scillæ, ℥ ss; extract. ipecac. fluid., ʒ ss; tinct. opii deod., ʒ j; syrup. tolutan., ʒ x. M. Sig.: *A teaspoonful every two, three, or four hours.* ℞ Scillæ, ipecac., āā, gr. vj; ext. hyoscyami, gr. iij; morphinæ sulph., gr. ss—gr. j. M. Ft. pil. no. xij. Sig.: *One pill every four hours.* In chronic bronchitis with emphysema or dilated right cavities of the heart, squill is better associated with the stimulating expectorants, ammoniac, asafœtida, benzoin, etc. ℞ Syrup. scillæ, ℥ ss; tinct. opii camphor., ʒ ij; ammoniac, ʒ ss; syrup. tolu., ʒ x. M. Sig.: *A teaspoonful as necessary.* Squill is an improper remedy when there are present fever and an acute inflammatory condition of the air-passages.

Squill is a very effective diuretic. Since in overdoses it will produce great irritation of the kidneys, it is inadmissible in acute affections of these organs. In dropsy caused by any of the chronic diseases of the kidneys, squill must be used with caution. As a diuretic this remedy is more especially useful in *cardiac dropsy.* It may be combined with digitalis or the saline diuretics. ℞ Infus. digitalis, ℥ iijss; acet. scillæ, ℥ ss. M. Sig.: *A tablespoonful two or three times a day.* ℞ Digitalis, ℈ j; scillæ, gr. x; ext. colchici acet., ℈ j. M. Ft. pil. no. xx. Sig.: *One pill every four or six hours.* When anæmia is present, iron may be added to the above formula. ℞ Acet. scillæ, ℥ ss; liq. potassii citratis, ℥ iijss. M. Sig.: *A tablespoonful every four hours.*

Authorities referred to:

FLÜCKIGER AND HANBURY. *Pharmacographia.*
HUSEMANN, DR. THEOD. *Handbuch*, zweiter Band, p. 1175.
KÖHLER, DR. HERMANN. *Handbuch*, p. 515.

Petroselinum.—Parsley-root. The root of *Petroselinum sativum*. (Not official.)

Composition.—The most important constituent of parsley is *apiol*, an oily, non-volatile, yellowish liquid, having a distinctive odor and an acrid taste. It contains, also, a gelatinous substance, *apiine* (pectin ?), and a volatile oil.

Actions and Uses.—Petroselinum has a hot, pungent taste, with an after acrid sensation. It is somewhat laxative—a property, doubtless, dependent on the irritation which it produces. It is stimulant in its effects on the circulation, and promotes the cutaneous and bronchial secretions. It is diuretic, by reason of the local irritant action of the principles which are eliminated by the kidneys.

Apiol has decided properties, and in its action strongly resembles quinine. It produces headache, tinnitus aurium, vertigo, intoxication, etc.*

Petroselinum is rarely employed for its diuretic effects. Its use is indicated in *dropsy* under the same conditions as juniper, squill, and other stimulating diuretics. It may be given in the form of infusion (℥ j—Oj), one to three ounces at each dose.

Apiol is a remedy of considerable value in the treatment of *malarial diseases*, but it is inferior in every respect to quinine. Its use is only justifiable in the treatment of *intermittents*, and when the prejudices or idiosyncrasies of the patient forbid the use of quinine. Fifteen grains should be administered in one dose, or in divided doses, within an hour, in order to procure the maximum effect, and about four hours previous to the paroxysm.

The evidence is conclusive that *apiol* has decided *emmenagogue* power. It is a stimulant to the uterine system, and therefore is contraindicated in plethora of these organs, and should not be administered as an antiperiodic to pregnant women. It is indicated when a state of torpor of the ovaries and uterus exists. The *amenorrhœa* of anæmia, of functional inactivity, is the form of the malady in which apiol is serviceable. The condition of the blood should be corrected by iron, constipation should be removed by aloëtic purgatives, and the apiol, in a considerable dose (fifteen grains), should then be administered at the time of the menstrual molimen, or just preceding the time when the flow should begin. If the case has been obstinate, a daily dose of apiol may be given for a week, or at least for several days before the menstrual period. The neuralgic form of *dysmenorrhœa* is also benefited by this remedy. Other *neuralgiæ* are, it is said, relieved by apiol, but the existence of a malarial cause is, no doubt, the explanation of its curative action in such cases.

Authorities referred to :

Delorme, Dr. *Gazette des Hôpitaux*, 1860, p. 511.
Joret and Homolle. *Bulletin Général de Thérapeutique*, vol. xlviii, p. 32.

Marotti, Dr. Ibid., 1863, p. 295.
Stillé, Dr. A. *Therapeutics and Materia Medica*, vol. ii, p. 631.

Polygonum Hydropiperoides.—Water-pepper. This indigenous plant is not recognized by the United States Pharmacopœia. A fluid extract prepared according to the general directions of the United States Pharmacopœia may be prescribed in the dose of ♏ x to ʒ j. A solid extract is also to be found in the shops—dose, gr. j—gr. v.

Actions and Uses.—The taste of hydropiper is hot, pungent, and acrid. The juice excites inflammation and vesication when applied to the external integument. In medicinal doses it causes a sensation of warmth in the stomach, and a "peculiar tingling sensation throughout the whole system" (Eberle). Unless given in an overdose it does not excite vomiting or produce purging. It stimulates the heart and arteries, increases the warmth of the surface, and promotes the cutaneous, bronchial, and renal secretions. It stimulates the menstrual flow, and is aphrodisiac.

This indigenous but little known remedy is a very efficient stimulating *diuretic* and *emmenagogue*. The author can confirm the statement of Eberle, who reports that "with no other remedy or mode of treatment has he been so successful as with this," in *amenorrhœa*. It is adapted to cases of amenorrhœa due to functional inactivity or torpor of the uterine system, and is contraindicated when a condition of plethora or congestion exists. The administration of this remedy should be begun about a week before the menses ought to appear. Thirty minims of the fluid extract should be administered four times a day. If anæmia exist, iron should be given ; if constipation, aloes.

Hydropiper is a remedy of considerable power in *functional impotence*. When the erections are feeble, the seminal fluid watery, and the testes soft, good results will be obtained from the use of this remedy, provided no structural alterations hinder or prevent improvement.

When hydropiper is administered in these disorders of the sexual system, it causes a feeling of weight and tension, and dragging of the pelvic viscera. As it tends to increase the blood-supply to these organs, it is inadmissible when a state of congestion or inflammation exists.

Authorities referred to :

Eberle, Dr. John. *A Treatise of the Materia Medica and Therapeutics*, fourth edition, vol. i, p. 441.
Porcher, Dr. F. Peyre. *Resources of the Southern Fields and Forests*, p. 409.

Ruta.—Rue. The leaves of *Ruta graveolens*. (Not official.)

Composition.—The medicinal activity of this plant depends on the presence of a *volatile oil*. Only the fresh leaves should be employed, and, as drying impairs the quality of the drug, the oil should be prescribed.

Oleum Rutæ.—Oil of rue. This is a volatile oil, of a greenish-yellow color, very disagreeable and characteristic odor, and pungent, acrid taste. Dose, ♏ j—♏ v.

Actions and Uses.—In its local action rue is an irritant; applied to the skin, the oil causes heat, inflammation, and vesication. In ordinary medicinal doses a sensation of warmth follows its introduction into the stomach, and increased action of the heart and arterial system and a subjective feeling of peripheral heat are subsequently produced. The cutaneous, bronchial, and urinary excretions become more abundant, and the odor of the volatile oil is apparent in the breath, the sweat, and the urine. In toxic doses the oil of rue produces violent gastro-enteritis, prostration, convulsive muscular movements, hebetude of mind, etc., strangury and suppression of urine. In women the use of rue increases the menstrual flow, and large doses may cause abortion to take place. In men this agent promotes the sexual appetite, and increases the vigor of the erections.

A tincture of the oil of rue is an efficient carminative and antispasmodic remedy in the *flatulent colic* and *hysteria* of women. Almost the only use of rue at present is in the treatment of *amenorrhœa.* It is one of the most efficient emmenagogues. Plethora, congestion, or inflammation of the pelvic viscera, contraindicate its use. Functional inactivity of the ovaries and uterus is the condition which justifies the employment of rue. It has been recommended in *menorrhagia* when the vascular tonus is low, and in *uterine hæmorrhage* after miscarriage. It need hardly be remarked that the condition of pregnancy forbids the use of rue.

Sabina.—Savine. The tops of *Juniperus sabina* Linné (Nat. Ord. *Coniferæ*). *Sabine*, Fr.; *Säbenkraut*, Ger.

Composition.—Savine contains an *essential oil,* in the proportion of two to two and a half per cent in the tops and about ten per cent in the berries. The oil of savine is isomeric with the oil of turpentine.

Oleum Sabinæ.—Oil of savine. Dose, ♏ j—♏ v.

Extractum Sabinæ Fluidum.—Fluid extract of savine. Dose, ♏ v—♏ xv.

Actions and Uses.—Savine has a strong, disagreeable odor, and a pungent, acrid taste. Applied to the skin, the oil causes inflammation and vesication, if the contact be sufficiently prolonged. Introduced into the stomach in a full medicinal dose, a sensation of heat, eructations tasting of the oil, flatulence, and nausea, are produced. A toxic dose sets up a violent gastro-enteritis. The oil diffuses readily into the blood, and is excreted by various channels—the breath, the sweat, and the urine smelling strongly of it. Increased action of the heart and a rise of tension of the arterial system, followed by diminished tonus of the vessels, result from its administration in full medicinal doses. The cutaneous, bronchial, and urinary excretions are rendered more abundant by savine. Strangury and bloody urine are caused by it in overdoses. The evidence is conclusive that savine exerts a powerful influence on the uterine system. It increases the menstrual flux, and in toxic doses may originate uterine action and cause abortion. The abortifacient effect can not be obtained unless by the administration of a quantity sufficient to endanger life.

The only use to which savine is now applied is in the treatment of *amenorrhœa.* It is generally conceded that the estimate of its powers made by Pereira is not extravagant, namely, that "it is the most certain and powerful emmenagogue of the whole materia medica." Savine is indicated in amenorrhœa dependent on deficient activity of the sexual system, accompanied by general atony. It is inadmissible when a tendency to congestion of the pelvic viscera is present, or in a condition of general plethora. Cases of *dysmenorrhœa* are benefited by savine when the subject is of relaxed habit, the menstrual flow being scanty, provided narrowing of the cervical canal is not the cause of the painful and difficult menstruation. *Menorrhagia,* when due to an enlarged, relaxed, and passively congested uterus, and *hæmorrhage after abortion,* may sometimes be arrested by this agent.

The most effective preparation of savine is the oil. This may be prescribed in gelatin-capsules, in an emulsion, or in pilular form. The fluid extract, if made from the fresh tops, is an excellent preparation. Combination with other remedies of the same group increases the action of savine. ℞ Ol. sabinæ, ʒ j; ol. rutæ, ʒ j; tinct. polygon. hydropiper, ℥ j; ol. amygdal. express., mucil. acaciæ, aquæ menth. pip., āā ʒ ij. M. Sig.: *A teaspoonful twice or three times a day as an emmenagogue.*

Authorities referred to:

ARAN, M. *Bulletin Général de Thérapeutique,* vol. xxx, p. 61.
BEAU, M. LE DR. Ibid., vol. xliii, p. 140.
FLÜCKER AND HANBURY. *Pharmacographia.*
HUSEMANN, DR. THEODOR. *Handbuch,* zweiter Band, p. 1200.
KÖHLER, DR. HERMANN. *Handbuch,* p. 387.
TAYLOR, DR. A. S. *On Poisons,* third edition, London, p. 494.
VAN DE WARKER, DR. ELY. *The Detection of Criminal Abortion,* 1872.

Cantharis.—*Cantharides. Cantharis vesicatoria. Cantharide,* Fr.; *Spanische Fliegen,* Ger.

Tinctura Cantharidis.—Tincture of cantharides. Dose, ♏ ij—♏ xv.

(The other preparations of cantharides, which are used externally only, will be taken up in Part III of this work.)

COMPOSITION.—The principal constituent of cantharides is a neutral, crystallizable principle, *cantharidin.* It contains also an oil, fatty matter, and an odorous material.

ANTAGONISTS AND INCOMPATIBLES.—There is no chemical or physiological antagonist to cantharides. Poisoning by this substance should, therefore, be treated on general principles. The stomach should be evacuated by emetics or the stomach-pump; mucilaginous substances should be freely administered; the gastro-enteritis should be treated by opium, etc.

SYNERGISTS.—Oils and fats increase the solubility and favor the absorption of cantharidin. The physiological actions of this agent are promoted by the other members of this group.

PHYSIOLOGICAL ACTIONS.—The odor of cantharides is nauseating, fetid and peculiar. In contact for a sufficient time with the skin or mucous membrane, it excites considerable burning, inflammation, and vesication. In the stomach it causes a sensation of heat, severe gastralgia, nausea, and vomiting. Notwithstanding the insolubility of cantharidin, it readily diffuses into the blood. It is actively stimulating to the circulatory system, and a rise of temperature, with thirst, follows in an hour or two. Under these circumstances, the urine becomes scanty and burns the passages; severe pain is experienced in the back and loins; priapism occurs; and the urine, voided with great difficulty, frequently contains albumen and blood. To this excitement of the circulatory system and of the genital organs succeeds a condition of depression, in which the pulse falls, the arterial tension is lowered, and the temperature declines (Radecki).

When a toxic dose is swallowed, in a short time a sense of constriction of the œsophagus, with difficulty of swallowing, and ptyalism, occur. Intense gastric pain, vomiting of glairy mucus streaked with blood, intestinal pain, abdominal tenderness, tenesmus, and mucous and bloody stools, are produced. Violent irritation of the genito-urinary organs is also experienced, manifested by lumbar pain, strangury and bloody urine, priapism, swelling and inflammation of the external genitals. In most cases of poisoning by cantharides, cerebral effects, consisting of muscular trembling, partial or general convulsions, coma, and insensibility are produced. Abortion has been caused by toxic doses of cantharides, and after death violent metro-peritonitis, gastro-enteritis, and general peritonitis, have been observed. It is questionable whether abortion can be caused by a dose less than toxic.

Cantharides has frequently caused dangerous symptoms, when used with a view to induce venereal excitement. That it does promote the sexual appetite is probably true, but this result is accomplished only by the use of a quantity sufficient to cause vascular turgescence of the sexual organs.

THERAPY.—In *acute desquamative nephritis*, after the subsidence of the acuter symptoms, good results are obtained from cantharides. The local condition in which this remedy is serviceable consists in hyperæmia with loss of vascular tonus. *Chronic pyelitis* and *chronic catarrh of the bladder* are occasionally remarkably benefited by the long-continued use of small doses of cantharides. *Irritability of the bladder,* more especially as it occurs in women, without the existence of acute inflammation, and not produced by uterine displacements, is sometimes quickly and entirely relieved by this remedy. The irritable state of the bladder and the vesical tenesmus, which accompany chronic prostatic disease, are also sometimes surprisingly relieved by cantharides, but the author is unable to indicate the special circumstances to which it is adapted.

Gleet and *prostorrhœa* are benefited by cantharides when these maladies occur in subjects of a relaxed fiber, with feeble circulation. Ringer makes the extraordinary statement that one drop of the tincture given three times a day will prevent *chordee.*

When *spermatorrhœa* actually exists, and is due to deficient tone of the seminal vesicles, the erections being feeble, and the sexual feeling torpid, good results are obtained by the use of cantharides. In cases of *scanty menstruation,* occurring in women of lax fiber, with cold hands and feet, improvement follows the use of this remedy. It sometimes happens that *menorrhagia* is due to relaxed vessels and a general lowering of the vascular tonus: under such circumstances cantharides may render important service. In these disorders of the sexual system, characterized by deficient power, the good effects of cantharides are promoted by the use of iron. The tincture of cantharides is the most eligible preparation for internal administration. In chronic affections of the genito-urinary passages the dose will range from five to fifteen drops, rarely the latter, three times a day.

Liebreich has brought forward cantharidin as a remedy for phthisis, based on the action of this agent on the capillaries whereby an abundant diffusion of blood serum takes place about pathological new formations. Now it is a well-known fact that blood serum is destructive of pathogenic micro-organisms. Hence his contention that to arrest the progress of tuberculosis it is only necessary to inject subcutaneously an agent like cantharidin, which environs the organism and cuts it off from further extension by causing an outpouring of serum about the tubercular deposit. Cantharidin has acid properties and combines with bases to form salts. Liebreich recommends the following combination: Cantharidin (cryst.), 3 grains (0·2 grm.); potassium hydroxide (pure), 6 grains (0·4 grm.); water, 5½ drachms (20 grm.). Heat over a water bath until clear; then add, while still on the water bath, and very cautiously, cold water enough to make when cooled 1 litre (32 fluidounces). The dose should never exceed $\frac{1}{100}$ grain of cantharidin, and the initial quantity ought not be greater than one third of that.

Good results have apparently followed this treatment, and the views of Liebreich have been supported by Fränkel, Guttman, and others.

Authorities referred to :

Casper's *Practisches Handbuch der gerichtlichen Medicin*, by Liman, zweiter Band, p. 574.

Husemann, Dr. Theod. *Handbuch*, zweiter Band, p. 538 *et seq.*

Rabeck, Fr. *Die Cantharidenvergiftung.* Inaug. Diss. *Schmidt's Jahrbücher*, vol. cxxxvii, p. 17.

Ringer, Dr. Sydney. *Handbook of Therapeutics.*

Taylor, Dr. A. S. *On Poisons*, fourth edition, London, p. 524.

Urotropin.—From *uron*, urine, and *trepo*, to change, a proprietary designation of a remedy intended to remove certain morbid states of the genito-urinary apparatus. It is formed by the combination of ammonia and formaldehyde, and occurs as colorless crystals, readily soluble in water. The dose for internal administration is usually about thirty grains *per diem*, or five to ten grains every four hours. It is readily diffusible, and appears in the urine in about fifteen minutes after it is swallowed. Either urotropin or its constituent, formaldehyde, is always to be found in the blood or urine in its passage through the system. When given in full doses, it may cause a sensation of heat, even burning along the course of the urethra or at the neck of the bladder, and increase the desire to urinate.

The most important property of urotropin is to render urine acid again that had become alkaline. This it accomplishes by inhibiting the septic organisms, that being about the alkalinity.

Urotropin has been used with success in effecting the solution of uric acid calculi. In pyonephrosis, with or without phosphatic concretions, it has restored the integrity of the mucous membrane, and stopped permanently the process of suppuration. Much relief has been effected by its use in enlarged prostate, with the resulting alterations in the bladder.

PART III.

II. TOPICAL REMEDIES.

COUNTER-IRRITATION.

The Theory of Counter-Irritation.—The application of counter-irritation as an expedient of therapeutics has never failed of appreciation, how vague soever have been the notions as to its mode of action, and how much these notions have varied from age to age. Before physiology had obtained the data on which a proper theory could be founded, the dogma of some master was submissively accepted by his followers, until a more specious theory was brought forward to displace it.

When the work of Magendie, the pioneer, and of Bichat, the interpreter and clinician, laid the foundations of physiological therapeutics, a true conception of the *methodus medendi* was dimly foreshadowed. Then the relation of the nervous centers to certain disorders of nutrition—e. g., the myopathies of spinal origin—and the alterations of the structure of nerve-centers induced by pathological states of the peripheral nerves, became established facts, and, in consequence, the influence of counter-irritation began to be rationally interpreted. Already the doctrine of reflexes had been universally established, and now the condition of the vessels as regulated by a system of dilator and constrictor organic muscular fibers, which are influenced by sensory impressions at distant points, has become a well-recognized fact of physiology. These data given, the principles of counter-irritation are no longer obscure, and no dogma is needed to give them concrete expression.

When the skin is irritated, by a mustard-plaster, for example, the superficial vessels of the part dilate, and an increased amount of blood is present in them. For a short distance around the part irritated, also, more or less dilatation of the vessels takes place. In this way a small amount of blood may be temporarily imprisoned. The influence which the retention in an external part of so small an amount of blood has on the general circulation, must be very slight. The obvious relief often afforded by a mustard-plaster can hardly, therefore, be ascribed to this limited withdrawal of blood.

An irritation established in the neighborhood of a part in which a morbid action is proceeding may, by reason of the contiguity of the tissues, affect the vascular supply to the diseased textures. *Ubi irritatio, ibi fluxus;* but, in order that the fluxion shall modify diseased action, it is necessary that there be a continuity of the vascular connections. The method of Furneux Jordan, which consists in the application of the counter-irritant to the neighboring vascular area, is based on this principle.

An irritation which consists in a local fluxion, and a state of altered sensibility in the nerves of the part, may affect the functions of distant organs. Counter-irritation applied to a considerable surface increases the action of the heart, raises the temperature of the body, and exalts the irritability of the nervous system. These are the general or systemic effects. Distinctly localized results are also produced. When one hand is immersed in cold water, a positive fall of temperature takes place in the other. Irritation of the lumbar region, as Brown-Séquard has shown, is followed by contraction of the vessels of the kidneys. Extensive injury to the surface of the body, by burning or scalding, may excite ulcerative action in the duodenum, or may set up a pneumonia. Injury to a motor-nerve trunk may be followed by ascending neuritis and serious atrophic changes in the multipolar ganglion-cells of the anterior columns. It follows from these facts that an irritation of the surface which involves the end-organs of the nervous system will affect the caliber of the arterioles and modify the functions of the trophic nerves. In these results we find a rational explanation of the *methodus medendi* of counter-irritation.

Certain other physiological laws deserve attentive consideration in this connection. An irritation which first produces a tetanic state of the vaso-motor nervous system may, if too long continued, exhaust the irritability of the organic muscular fiber, and cause paresis. Moderate irritation will exalt the functional power of the trophic centers; but excessive and long-continued injury to the surface may set up atrophic changes, of which there are numerous examples. In these physiological facts also we find a rational explanation of the injury not unfrequently done by too powerful or too protracted counter-irritation.

Vesicants, in addition to the effects of counter-irritants sketched above, cause an exudation of serum. This exudation may have a twofold effect: 1. To lessen the gross amount of the blood-serum, and thus diminish the blood-pressure; and, 2. To remove toxic or pathological materials from the tissues and fluids of the inflamed part. More powerful systemic effects are produced, and vaso-motor paresis and trophic changes are more quickly induced, by blisters than by rubefacients.

FORMS OF COUNTER-IRRITANTS.

The remedies employed for the purpose of external irritation are divisible into two groups.

1. Rubefacients ;
2. Epispastics.

A *rubefacient* is a remedy which causes heat and redness ; but, if the contact with the skin be sufficiently prolonged, vesication may be produced. An *epispastic* is a remedy which excites inflammation and vesication. The first group of remedies are restricted in their application to such therapeutical results as can be attained by a superficial and temporary action in the skin. The second group are intended for more permanent action and a deeper impression on internal organs. These remedies differ not only in the degree, but in the character of the effects produced. An impression on the periphery induces some kind of molecular modification at the center. According as the impression is slight or severe are the centric modifications localized to the point of reception or transferred to distant points (reflex impressions). According to the severity of the peripheral impression are the resulting local centric disturbance and the reflex changes (trophic alterations). Thus a slight peripheral rubefaction may cause a trivial centric vascular spasm, but an extensive burn on the body may induce vaso-motor paresis, and consequent inflammatory changes in remote organs.

RUBEFACIENTS.

Sinapis Alba.—White mustard. The seed of *Brassica alba* Linné (Nat. Ord. *Cruciferæ*).

Sinapis Nigra.—Black mustard. The seed of *Brassica nigra.*

Charta Sinapis.—Mustard-paper.

Composition.—When water is added to pulverized black mustard, pungent, irritating fumes are given off. These fumes consist of the *volatile oil of mustard* (allyl sulphocyanide). This volatile oil is produced by a reaction between certain constituents of the seeds—*sinigrin* (myronate of potassium) and *myrosin*—in presence of water, and at a temperature below 100° Fahr. The boiling-temperature destroys the ferment, myrosin, and hence prevents the formation of the volatile oil. Mustard contains also a bland fixed oil, which may be procured by expression.

White mustard contains an indifferent, crystalline substance, *sinalbin*, and *myrosin*. Sulphocyanate of acrinyl, a product of the reaction between sinalbin and myrosin, is the rubefacient principle of white mustard (Flückiger and Hanbury). White mustard contains also an alkaloid—*sinapine*. The chemical composition of the two kinds of mustard is, it will be seen, closely analogous. Myrosin exists in white mustard in larger proportion than in black, hence a considerably larger quantity of the volatile oil of mustard is formed when an addition of white mustard is made to the black.

A great variety of plasters and liniments (some referred to already in their appropriate connections) are employed to induce a rubefacient action.

EMPLASTRA.

Emplastrum Capsici.—Capsicum plaster (a resin plaster on which is spread a thin layer of oleo-resin of capsicum).

Emplastrum Resinæ.—Resin plaster (resin, lead plaster, and yellow wax).

Emplastrum Saponis.—Soap plaster (soap, 100 grm.; lead plaster, 900 grm.).

Emplastrum Arnicæ.—Plaster of arnica (extract of arnica-root, 330 grm.; resin plaster, 670 grm.).

Emplastrum Picis Burgundicæ.—Burgundy-pitch plaster (Burgundy pitch, 800 grm.; yellow wax, 150 grm.; olive-oil, 50 grm.).

Emplastrum Picis Cantharidatum.—Plaster of pitch with cantharides (Burgundy pitch, 920 grm.; cerate of cantharides, 80 grm.).

LINIMENTA.

Linimentum Calcis.—Lime liniment (equal parts of lime solution and cotton-seed oil).

Linimentum Cantharidis.—Cantharides liniment (cantharides, 15 parts; turpentine, q. s. to make 100 parts).

Linimentum Sinapis Compositum.—Compound mustard liniment (volatile oil of mustard, extract of mezereum, camphor, castor-oil, and alcohol).

Linimentum Ammoniæ.—Liniment of ammonia (water of ammonia, 350 c. c.; cotton-seed oil, 600 c. c.; alcohol, 50 c. c.).

Linimentum Camphoræ.—Liniment of camphor (camphor, 200 grm.; cotton-seed oil, 800 grm.).

Linimentum Saponis.—Soap liniment (soap, 70 grm.; camphor, 45 grm.; oil of rosemary, 10 c. c.; water, q. s. to make 1,000 c. c.; alcohol, 750 c. c.).

Linimentum Terebinthinæ.—Liniment of turpentine (resin-cerate, 650 grm.; oil of turpentine, 350 grm.).

Linimentum Saponis Mollis.—Liniment of soft soap (soft soap, 650 grm.; oil of lavender, 20 c. c.; alcohol, 300 c. c.; water, q. s. to make 1,000 c. c.).

Linimentum Chloroformi.—Chloroform liniment (chloroform, 300 c. c.; soap liniment, 700 c. c.).

Linimentum Belladonnæ. — Belladonna liniment (camphor, 50 grm.; fluid extract of belladonna, q. s. to make 1,000 c. c.).

A *turpentine-stupe*, which is one of the most frequently-used extemporaneous counter-irritants, is made as follows: A piece of flannel folded in several layers, or a piece of spongio-piline, is wrung out in hot water, and a few drops (five to fifteen) of turpentine are sprinkled over it. This is placed over the affected region, and is confined by a towel or napkin pinned around the part. Turpentine, applied in this way, is a very active rubefacient, and may even vesicate, so that attention is required to avoid overaction.

EPISPASTICS.

Ceratum Cantharidis.—Cantharides or blistering cerate.

Ceratum Extracti Cantharidis.—Cerate of extract of cantharides.

Charta Cantharidis.—Cantharides-paper.

Collodium Cantharidatum.—Collodion with cantharides.

Linimentum Cantharidis.—Liniment of cantharides.

Firing.—By the method of firing, merely rubefacient or vesicating effects are produced. Firing is accomplished by the application of an iron disk provided with a suitable handle (Mayer's hammer). It is dipped into boiling water, and then passed, more or less rapidly, over the skin of the part to be acted on. Very brief contact suffices to vesicate, and this is the usual effect of the application.

Of the above preparations the most efficient is the *ceratum extracti cantharidis*, the most elegant the *charta cantharidis*, and the most convenient the *collodium cum cantharide.* The cerates should be spread on adhesive plaster, leaving a margin of the plaster to secure adhesion to the skin. Before the application of a blister, if prompt action is necessary, a mustard-plaster should be laid on long enough to produce rubefaction, or the skin should be rubbed with turpentine. When the skin is very thin and sensitive, the blister should be covered with tissue-paper. When the vesication is to be permitted to heal in a short time, or when young and irritable subjects are to be blistered, the cantharides-plaster should be removed when distinct redness of the skin is produced, and a poultice applied, which will develop the vesicles. The length of time required for a blister "to draw" is influenced by the age of the subject and the condition of the skin. From two to twelve hours, as a rule, will elapse before vesicles appear; and, when a very deep impression is intended, the blister may remain even twenty-four hours. In infants and in certain states of the constitution (scorbutus, purpura, scarlatina, etc.), prolonged contact of a cantharides-plaster may cause deep sloughing and very severe nervous symptoms, and adynamia.

When the vesicles are fully developed, they should be punctured at the most dependent point, and the serum, as it escapes, absorbed by a soft cloth. If the blistered surface is to be allowed to heal, a dressing of raw cotton suffices. If discharge is to be encouraged, resin-cerate or savine-cerate may be applied, spread on a cloth perforated to permit the discharge to exude, and covered with raw cotton to absorb the fluid. If the blister is slow to heal, boracic-acid lotion is an efficient application, or a weak lead-lotion may be used.

Therapy.—Various methods of counter-irritation are employed in the treatment of diseases of the abdominal viscera. For the relief of *nausea*, *vomiting*, *diarrhœa*, *colic*, *cholera-morbus*, etc., no expedient is more generally useful than a mustard-plaster. In *persistent vomiting*, a small blister applied to the epigastrium will often afford permanent relief. The good effects of a blister in such cases are enhanced by dusting over the exposed derma some powdered morphine. In acute inflammatory affections—*typhlitis*, *peritonitis*, *puerperal peritonitis*, *pelvic cellulitis*, etc.—the best results are obtained by the use of turpentine-stupes during the acute stage, and the application of blisters after the acuter symptoms have subsided. The prolonged contact of blisters with the abdominal wall of thin subjects has set up peritonitis by contiguity of structures. The author has observed instances of this kind, and analogous cases have been reported.

In chest-diseases—*pleuritis*, *pneumonia*, *pericarditis*, etc.—some form of counter-irritation is invariably employed, and is often greatly abused. At the onset of these maladies a large mustard-plaster to the chest, allowed merely to redden the skin, is an excellent expedient; during the progress of the inflammation the turpentine-stupe is generally the best application; to assist in the process of resolution and repair, the more permanent action of a blister will be serviceable. Much has been said about the "blistering-point" in pneumonia. The discussion is resolvable into this: during the inflammatory stage, blisters are harmful, because they stimulate the nervous and vascular systems, and are useful when the crisis occurs, to assist in the liquefaction and absorption of inflammation products. At the very inception of an acute thoracic disease a flying blister may render the same service as a mustard-plaster, but it possesses no advantage over the latter. A succession of "flying blisters" appears to be useful in *hydrothorax*, to promote absorption.

Counter-irritants are much abused in the treatment of *phthisis* at its various stages. The chest-pains which accompany this disease can usually be relieved by mustard and belladonna plasters. Intercurrent attacks of pleuritis and pneumonia may be treated by the milder forms of irritation. The pustulation of the chest with croton-oil or tartar-emetic ointment is rarely if ever justifiable, and deep blistering is always harmful.

In *acute inflammation of the meninges, cerebral or spinal*, blisters are often employed, but there is singularly little proof of their utility. When used, they should be confined to the mastoid processes or to the nape of the neck. Under no circumstances is it ever justifiable to shave and blister the scalp, as was formerly not unfrequently done in various forms of cerebral disease. An *aura* proceeding from an extremity may be intercepted, and attacks of *epilepsy* averted, by encircling the limb with a strip of blistering-plaster. Various instances of the success of such a blister have been reported. *Hysterical paralysis* is most successfully treated by encircling the affected extremity with narrow blisters (Reynolds), and *hysterical aphonia* may sometimes be very quickly cured by a blister to the larynx. The curative effect of such an application is doubtless due to the moral impression of the counter-irritant. Blisters over the course of the affected nerve are of great service in *neuritis*. The good effect of the blisters is increased by treating the blistered surface with morphine. There can be no doubt of the curative value of blisters in *neuralgiæ*. According to Anstie, it is not the mental impression produced by the pain of the blister, and not the withdrawal of serum from the focus of pain, which explain their efficacy, but they act "as true stimulants of nerve-function." The best point at which to apply the blister is "as close as may be to the intervertebral foramen from which the painful nerve issues." Flying blisters are to be preferred, and, as a rule, exudation of serum is not to be encouraged.

Lumbago, myalgia, and fugitive but recurring muscular pains, are sometimes relieved by the warming plasters given at the head of this article, or by frictions with ammonia-liniment, turpentine-liniment, etc.

Blisters are, as a rule, inadmissible in acute affections of the kidneys and bladder. A succession of blisters to the perinæum is unquestionably serviceable in *chronic prostatitis* and in *gleet.*

Inflammatory affections of the eye and ear are, as a rule, benefited by the application of blisters in the neighborhood of these organs.

The application of blisters is an effective method of treating *acute rheumatism.* According to the plan of Davies and Dechilly, the affected joints are enveloped in blisters, which are allowed to remain until thorough vesication is produced and serum is abundantly discharged. The author, who has had considerable experience in the treatment of rheumatism by this method, finds that a number of small blisters applied around the joint are as effective and less painful. The good effects of the blister-treatment are these: the pain and swelling are abated, the danger of cardiac complication lessened, and the duration of the disease shortened. It is a singular fact that the urine becomes neutral or alkaline under the action of blisters. The curative effect of blisters is not, probably, to be ascribed to the withdrawal of acid serum from the affected joints, but rather to an influence exerted through the trophic nerves on the metamorphosis of tissue.

As general stimulants, rubefacients and vesicants are employed to arouse the vital processes in a condition of great depression or collapse from any cause, e. g., *cholera, pernicious malarial fever, uræmia, narcotic poisoning,* etc.

Contra-indications of Blisters.—The acute stage of an inflammation; pregnancy; scorbutus and purpura; infancy; debility; are conditions rendering their use improper and injurious.

The strangury produced by blisters is lessened by the free use of diluent drinks, and is relieved when it occurs by an enema of laudanum or the hypodermatic injection of a minute quantity of morphine. A decoction of uva-ursi freely drunk will, it is said, prevent strangury, but the effect of this remedy is, probably, not greater than that of an ordinary diluent.

The method of "firing" is sometimes very beneficial in *neuralgia*, *spinal irritation*, *myalgia*, etc. The effects can be regulated by the temperature of the hammer, and by the duration of the contact with the skin, and may vary in severity from the mildest rubefaction to vesication, and even destruction of the skin.

Acupuncture.—Needles about three inches in length, and having a red wax, hard-rubber, or metal head, are employed for this purpose. They are introduced by a rapid rotary motion. Insulated needles are used in the same way for conveying the galvanic current to deeply-placed nerves.

Baunscheidtismus.—This is a form of acupuncture, so named from Baunscheidt, its inventor. "The instrument employed consists of a heavy disk, about half an inch in diameter, having inserted into it about twenty-five sharp needles, each about nine-sixteenths of an inch in length. To this disk a strong wire spiral spring (five and a half inches in length) is attached, and the other extremity of the spring is inserted into an elongated spindle-shaped handle." The spring and needles are contained in a cylinder, the handle attached. The following is the mode of using it: the open extremity of the cylinder is placed firmly on the skin; the handle is then drawn up, which compresses the spring; now, if suddenly loosed, the recoil of the spring drives the needles smartly into the skin. The punctures may be rubbed with a weak mixture of croton-oil, with cajeput-oil, or other suitable counter-irritant.

Actions and Uses.—These are methods of counter-irritation which appear to possess peculiar powers. The theories which have been proposed to explain their mode of action are far from satisfactory. The method of Baunscheidt is that of an ordinary counter-irritant added to the effects of acupuncture; but no explanation has hitherto been offered which accounts, in a rational manner, for the curative effects of acupuncture in certain maladies.

In *tic-douloureux*, *sciatica*, *lumbago*, and *myalgia*, it occasionally happens that remarkable and instantaneous relief is obtained by the insertion of acupuncture-needles deep enough to reach near the affected nerve.

When the patient is timid, the sensibility of the skin may be diminished by the application of chloroform for a minute, or of the ether-spray or methyl chloride. If rapidly rotated by the finger and thumb, the needle will penetrate with little suffering.

Aquapuncture.—The method of aquapuncture consists in the introduction of water subcutaneously, or into the substance of muscles. A special instrument has been invented for this purpose; the advantage of which consists in its being armed with several needles, which permit the introduction of the water at various points simultaneously. Ordinarily, the hypodermatic syringe will suffice for the performance of this little operation, and, if patients object to repeated punctures, the sensibility of the skin may be obtunded by ether-spray.

When water is injected under the skin, more or less pain, accompanied by burning, is produced. A wheal is formed about the site of the puncture, and redness of the skin and elevation of the temperature at that point follow. It is a remarkable circumstance that aquapuncture has the power to relieve pain in a superficial nerve. So decided is this effect that there are physicians who hold that the curative effect of the hypodermatic injection of morphine is due, not to the morphine, but to the water! In order that aquapuncture shall relieve pain, it is necessary that the water be injected into the neighborhood of the painful nerve. Injection at a remote and indifferent point would certainly fail of any effect except that reflex effect which is produced by any counter-irritant. Aquapuncture, however, has unquestionable power as a counter-irritant.

The method of aquapuncture has been employed with success, which must be regarded as extraordinary, in *neuralgiæ*, facial, sciatic, and lumbo-abdominal; in *lumbago, irritability of the bladder, uterine colic, gastralgia*, etc. The author has produced excellent effects from the injection of water into *paralyzed* and *wasting muscles*. It promotes the nutrition of muscles, and contributes to the regeneration of voluntary power. In the various cases to which this treatment is applicable, the quantity which should be injected will vary from thirty minims to a drachm. When the first injection does not relieve in two minutes, another should be practiced. It is insisted upon (Lafitte) that the water be injected at the painful points (*points douloureux*). There need be no limit to the number of the injections, if they afford relief; for, of course, no injury will result, unless it be the production of an abscess at the site of the injections, which is very rare.

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Jequirety.—Seed of *Abrus precatorius* of the Natural Order *Leguminosæ.*

Description.—The name jequirety is a local designation, used by the rude peoples of Brazil to indicate its action in some forms of eye-diseases. The seeds—the part employed for topical purpose—are of a bright-scarlet color, very hard, ovoid in shape, and have a hilum surrounded by a black border.

There are differences of opinion as to the source of the pathogenic local action possessed by jequirety. It contains a bitter principle—*abrin*—a large proportion of vegetable albumin, and a ferment. An infusion, prepared at a proper temperature (below 60° C.), in a few hours is found to contain a vast number of microbes in active development, the albumin of the seeds being a soil peculiarly fitted for their sustenance and growth.

The infusion is the preparation used. The formula proposed by De Wecker is the following:

Thirty-two grains of jequirety are well pulverized and thoroughly triturated with two ounces of cold water. The mixture is allowed to macerate for twenty-four hours. Two ounces of warm water is then added, and the infusion filtered immediately on cooling. With this the part to be acted on is washed three times a day.

De Wecker also proposes a solution somewhat stronger than the foregoing: One hundred and fifty grains of the seeds (decorticated) are macerated for twenty-four hours in two ounces of cold water, and filtered. This, or the infusion given above, is applied to the eyelids for fifteen to thirty minutes, and a little is allowed to penetrate through the lids to the conjunctiva. The applications are kept up for three days, as a rule. This period is the "incubation period" of Sattler. As respects the pathogenic activity of the solutions, they differ somewhat according to their strength, but more according to their age. Deneffe, of Brussels, and Sattler (De Wecker's assistant), have described minutely, and, as our observations go, accurately, the process of inflammation resulting.

The application of the infusion to the eyes is free from pain, and it is not until the incubation period (three hours) has passed that the characteristic inflammation begins. Slowly at first, but then more rapidly, an acute, suppurative, and membranous inflammation develops, the lids are tumefied, glued together, and the conjunctiva coated with a yellowish-white croupous membrane, which reaches its maximum in twenty-four hours, continues at that point for the same period, and then slowly subsides, the last trace disappearing in four to six days. During the greatest height of the inflammation there is fever, sometimes as high as 104° Fahr.

The infective activity of a solution of jequirety is the greater the longer it is macerated—within suitable limits—and hence, by this expedient, solutions can be prepared to be adapted to all the varying conditions of disease. The strength most used is from 0·5 to 1 per cent.

A final decision has not been reached as to the constituent setting up the peculiar inflammation. Sattler, who discovered the ferment action and the formation of microbes, referred the inflammation to the pullulation of these organisms. Klein has proved, as he supposes, that the microbes do not have this pathogenic power. In turn, abrin has been, and has not been, considered the agent. Recent observations by Kobert indicate that abrin is the active agent in setting up the characteristic destructive inflammation. Abrin is so powerful an irritant, that if brought in contact with the mucous membrane or any wounded surface it causes violent reaction, and must therefore be handled with care.

Actions and Uses.—To apply a suggestive term to the action, jequirety sets up a substitutive inflammation to take the place of the existing morbid process. To what end? It is only the papillary granulations of the eye that are cured by jequirety. True granulations—*trachoma*—remain unchanged after the jequirety inflammation has passed. According to Deneffe, it is absolutely useless in the treatment of pannus. There are, however, ophthalmologists of high character who find jequirety very useful in these cases, and who explain failures by asserting that sufficient time was not given, and that persevering applications, extending over many months, are necessary in obstinate cases (Soloveitchik, Smirnoff, Tangeman, and others).

Jequirety has been successfully used in the treatment of fungous granulation of the external auditory canal. *Chronic metritis* of a severe type has been successfully treated, and *skin-diseases*, of hypertrophic character, resisting all other agencies, have been cured by painstaking applications. *Lupus* and *epithelioma*, especially the latter, *old ulcers* with thickened margins and sluggish in character, are quickly changed in condition, and, if curable at all, are disposed for healing.

The author must couple some cautions with these recommendations of jequirety. The subcutaneous injection of the microbe-laden infusion causes such general destructive changes in cold-blooded animals, and so much local mischief in mammals, that it should be practiced in man with great caution, if at all.

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BLOODLETTING.

Venesection, arteriotomy, cupping, leeching.—The manner of bleeding, whether by opening a vein or an artery, is a surgical subject, which it is not necessary to consider in this work.

PHYSIOLOGICAL ACTIONS.—Bloodletting may be employed for a systemic or local effect. Bleeding from a vein or an artery, by diminishing the whole quantity of the circulating fluid, and by altering its quality, affects the functions of every organ, and especially of organs the seat of an acute hyperæmia. Cupping and leeching, if carried far enough, may diminish the general blood-pressure and the proportion of the morphotic elements; but their action is largely local and revulsive.

The effects of bloodletting on the composition of the blood are these: the water is increased and the globules, fibrin, and salts are diminished in relative amount; an artificial anæmia is thus induced. The action of the heart becomes more rapid and its force lessened; the arterial tension falls, and the pulse assumes the dicrotic character. The functions of organs, especially of the brain and nervous system, lose energy. Nausea, vomiting, faintness, syncope, and epileptoid seizures occur, when the loss of blood is considerable. Epileptiform convulsions is a constant phenomenon in animals bled to death (Kussmaul and Tenner).

When the quantity of fluid in the vessels is lessened by bleeding, thirst is experienced, and absorption is more rapid; the sensibility to pain is diminished, probably, because the perceptive centers are functionally inactive; and the power to evolve force, muscular, digestive, nervous, etc., is greatly restricted. Only one function, therefore, is rendered more active by bleeding; all the others are depressed in consequence of the inadequate supply of nutrient material.

It is a remarkable fact, perfectly well known to old practitioners, and to which Sir James Paget has recently called attention, that the ill effects of bleeding, in healthy subjects, are very temporary and easily repaired. The blood-globules, which are relatively more affected by bleeding than the other constituents, are quickly reproduced, and the functions of organs suddenly very much depressed soon recover their normal energy. That any permanent injury is done to the healthy human system by a moderate bleeding seems, therefore, to be highly improbable.

Therapy.—The limits of this work will not permit the introduction of any controversial discussions. The author is to be ranked with those who do not employ general bloodletting, but he does not deny that it is occasionally useful; and that, indeed, it may be indispensable. A summary of the physical conditions in which venesection may be useful or indispensable should not, therefore, be omitted from a work on therapeutics.

The therapeutical effect of a general bloodletting in congestion and inflammation is largely mechanical. In *acute congestion of the lungs*, when aëration of the blood is seriously impeded; when there are extensive stasis on the venous side, and ischæmia on the arterial side of the systemic circulation, great relief may be afforded by the abstraction of from four to sixteen ounces of blood. In the *apoplectiform variety of acute cerebral congestion*, damage to the brain may be prevented by letting blood. The effect of the bleeding is to diminish the intra-cranial pressure, and thus relieve the strain on the cerebral vessels. In *eclampsia*, especially of the puerperal variety, accompanied with the evidences of cerebral congestion, great relief may be procured by the timely abstraction of blood. The quantity of blood to be taken will depend in part on the character of the subject and on the amount of congestion.

The mechanical effect of the withdrawal of blood from the systemic circulation may be most advantageous in cases of *sudden over-distention of the right cavities of the heart.*

Pulmonary hæmorrhage, when dependent on acute congestion of the lungs, the general condition being one of plethora, may be promptly arrested by opening a vein in the arm.

The *pain* of *acute pleuritis*, and *acute peritonitis*, can be quickly relieved by bloodletting.

Although it is undeniable that the important results above mentioned may be obtained from general bleeding, it is equally certain that as good results in most of the conditions may be had by other methods. Acute diseases make such serious demands on the vital resources of patients, that the practitioner should seriously ponder the propriety of taking blood even in those cases to the relief of which it may seem to be adapted. Large bleedings, experience has abundantly shown, render the convalescence from acute diseases tedious—for the patient has to make up the losses by venesection as well as the ravages of the disease.

Bleeding by Cups and Leeches.—A large number of cups and leeches may produce the systemic effects of a general bleeding. But, as a rule, these applications are intended to withdraw blood from the affected part, and thus act in the manner entitled revulsive. The local irritation caused by cups and leeches must, through the agency of the nervous system, affect distant parts in the same manner as other counter-irritants.

Leeches are preferable to cups when the parts are very sensitive or inaccessible. The quantity of blood drawn can be more accurately measured when cups are used. The counter-irritant effects are much more pronounced from cups than from leeches.

The amount of blood drawn by a leech will depend on its size, and the subsequent loss of blood, when the bleeding is encouraged, is determined by the vascularity of the part. As a general rule it may be stated that a leech will draw about four times its own weight—about one to two drachms. To obtain from any given patient four ounces of blood, one ounce of leeches must be applied.

In *acute gastric, enteric, and peritoneal inflammations,* if the patient be plethoric, and there is decided sthenic reaction, leeches to the abdomen are very serviceable. The number to be applied will always depend on the effect to be produced, employing the rules given above as the basis of the estimate. In *typhlitis and perityphlitis,* the author has seen such good results produced by leeches, that he holds they should never be omitted when the tenderness and fever begin. In *acute hepatitis* and *congestion of the liver,* and in *acute dysentery,* the best results are obtained by the application of leeches to the margin of the anus. *Hæmorrhoids* that are swollen, painful, and irreducible without great suffering, are much relieved by the application of leeches directly to them. *Pruritus of the anus,* when due to engorgement of the portal circulation, and accompanied by heat of the anal region, may sometimes be cured by leeching the parts affected.

Acute desquamative nephritis, pyelitis, and *congestion of the kidneys,* are ameliorated by the application of cups to the lumbar region.

The following acute affections of the respiratory organs, when they occur in robust persons, and are accompanied by sthenic reaction, are favorably influenced in their course and duration by the application of cups or leeches—usually the former : *pleuritis, pericarditis, acute tonsillitis, acute laryngitis,* and *inflammatory croup.*

In *acute inflammations of the uterus and its appendages,* decisively good results are obtained by the application of leeches to the hypogastric region, to the iliac fossæ, or to the uterus.

Cupping the nape of the neck, or leeches to the mastoid process, are probably of service in acute congestion or inflammation of the intracranial structures ; but the indiscriminate employment of bloodletting in any case of cerebral disease is to be condemned. The correct rule may be formulated as follows : When bloodletting is indicated in intracranial maladies, venesection or arteriotomy (temporal artery) is to be preferred to the use of cups or leeches.

Although good results are obtained by the local abstraction of blood in the diseases above mentioned, the author must express his conviction that the chief utility of cupping and leeching consists not in the blood withdrawn, but in the derivant and counter-irritant effect which they produce. *Dry cups*, a mustard-plaster, a turpentine-stupe, or other counter-irritant application, may render the painful process of cupping or leeching unnecessary.

ESCHAROTICS.

The substances belonging to this group are employed for the purpose of destroying the tissues to which they are applied. They differ in their mode of action, in the extent of the destruction which they effect, in their capacity for diffusion into the blood, and in the results which they severally accomplish.

They are prescribed for the purpose of cauterizing poisoned wounds —*syphilitic ulcers, snake-bites, the bites of rabid animals*—for the removal of *gangrenous parts, foul or exuberant granulations*, and especially for the destruction of *malignant growths*. When the diseased parts, to the destruction of which they are devoted, have been fully acted upon, the caustic action is ended; poultices are applied to favor the entire separation of the sloughs, and a healthy surface is finally left to heal by granulations.

The members of this group have, with one exception, been discussed elsewhere:

The mineral acids.
The chloride and sulphate of zinc.
Potassa fusa and potassa cum calce.
Arsenious acid.
The acid nitrate of mercury.
Bromine.

Acidum Chromicum.—*Chromic acid.* In deep-red, needle-form crystals, deliquescent, and very soluble in water, forming an orange-red solution.

Actions and Uses.—Chromic acid is an oxidizing caustic. When the action ceases, sesquioxide of chromium remains. It is slow in action, and not very painful, but it penetrates deeply and is remarkably destructive. Small animals, as mice and birds, are dissolved entirely, bones and all, by chromic acid. Owing to the fact that it penetrates deeply without much pain, care must be used in its application as a caustic, lest it injure parts which are not intended to be affected. When it is applied as a caustic, the surrounding tissues must be well protected. For the destruction of *malignant growths, hæmorrhoids, warts*, etc., the acid should be made into a paste by the addition of sufficient water. The part to which it is applied first becomes yellow, then brownish, and ultimately black, and the eschar is detached in from twenty-four to forty-eight hours.

A solution of chromic acid of the strength of one hundred grains to an ounce of distilled water is an efficient local application in *syphilitic* *warts and vegetations, condylomata, lupus, sycosis, tinea tonsurans*, etc. A still stronger solution (grs. xv — ℥ j of hot water) has been injected into the uterine cavity with success in cases of *uterine hæmorrhage* and *uterine catarrh* (Wooster).

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EMOLLIENTS, DEMULCENTS, AND PROTECTIVE AGENTS.

Glycerinum.—Glycerin. A colorless, inodorous, sirupy liquid, of a sweet taste, and having the specific gravity of 1·25. It is soluble in water and in alcohol, but not in ether.

Suppositoria Glycerini.—Suppositories of glycerin. (Glycerin, 60 grm.; sodium carbonate, 3 grm.; stearic acid, 5 grm. To make ten rectal suppositories.)

Glyceritum Vitelli.—Glyconin. An emulsion of glycerin and the yelk of eggs—45 grm. of the yelks and 55 grm. of glycerin. (U. S. P.)

Glycerin-Cream.—(Glycerin, 1; soft soap, 1; cherry-laurel water, 1.) (Squire.)

Glycerin-Cream with Camphor.—(Glycerin, 2; camphor, 1; rectified spirit, 1.) (Squire.)

Glyceritum Amyli.—Glycerite of starch. (Starch, 10 grm.; glycerin, 80 grm.; water, 10 c. c.)

Properties.—Exposed to the air, glycerin slowly absorbs moisture, but it does not evaporate, and it does not become rancid or undergo fermentation spontaneously. It is unctuous to the touch, and is obstinately sticky. Glycerin possesses remarkable solvent powers. One part of iodine and one of iodide of potassium dissolve in two parts of glycerin. Bromine, the iodide of sulphur, the chlorides of potassium and sodium, the alkalies, some of the alkaline earths, many of the neutral salts, the vegetable acids, especially tannic, most of the alkaloids (morphine, quinine, strychnine, veratrine, and atropine), and carbolic acid, are soluble in glycerin. The fatty acids, cocoa-butter, camphor, chloroform, calomel, iodide of lead, and the resins, do not dissolve in glycerin.

The antiseptic property of glycerin is decided. Vaccine lymph may be preserved unchanged almost indefinitely when stored up in pure glycerin; and anatomical preparations, and specimens of natural history, are kept in preservative solutions consisting chiefly of this substance. Microscopical and pathological specimens are after a time softened and disintegrated by pure glycerin.

Applied to the tissues of the body, glycerin, if pure, is perfectly bland and unirritating, as a rule, but in some subjects severe smarting is produced on contact of the purest glycerin with the mucous membrane. When it contains the fatty acids, oxalic or formic acids, it possesses very positive irritant qualities. It abstracts water from the tissues.

THERAPY.—No systemic effects are produced by the stomach administration of glycerin. It is an efficient remedy in *acidity, pyrosis,* and *flatulence,* in the dose of a drachm, before, with, or after meals.

Glycerin has been proposed and used as a substitute for cod-liver oil, in the various cachectic states in which the latter is prescribed. It has been conclusively shown that it is inferior to cod-liver oil in every respect. As a vehicle for the administration of cod-liver oil, it is extremely serviceable (glyconin, a teaspoonful ; cod-liver oil, a teaspoonful ; tincture of cinnamon, ten drops).

Good results have been reported from the use of glycerin in *diabetes,* but the data are as yet insufficient to enable a correct estimate of its real value to be made. The internal administration of glycerin has been resorted to for the removal of *acne* with success. It is said to destroy intestinal trichina, and may be given freely in trichinosis.

The most important applications of glycerin, besides its numerous uses as a vehicle, are topical as an emollient. Applied to the affected mucous membrane by means of a camel's-hair pencil, pure glycerin affords great relief in *acute coryza. Chronic follicular pharyngitis,* accompanied with profuse secretion, is generally improved by the same application, but the addition of tannic acid greatly enhances its curative power in this affection. A solution of morphine in glycerin, applied to the fauces with a brush, relieves the *cough of phthisis.* A better application in many respects is a mixture of glycerin, crystallized sugar, and whisky. This mixture, allowed to trickle slowly down the fauces, allays irritability and keeps the mucous membrane moist (glycerin, two parts ; whisky, one part ; crystallized sugar, a sufficiency).

An enema of glycerin and infusion of flaxseed (one to four) allays the tenesmus in cases of *acute dysentery.*

For *chapped hands or face,* glyconin is an excellent application. In *seborrhœa,* glycerin-cream gives good results. For *fissures of the nipple,* Stillé strongly recommends a "liniment made by adding one part of tincture of benzoin to six or eight of glycerin, and filtering the mixture."

In *pityriasis* and in the *papular eruptions,* glycerin is serviceable, but, in general, it may be stated that its use in skin-diseases is disappointing, and that it is inferior as a local application to the usual oils and fats employed in this way.

Glycerin has been used as a dressing for *wounds* and *ulcerated* *surfaces*, with more or less advantage. It is largely prescribed by gynæcologists as a topical application to erosions and ulcerations of the cervix uteri, and for the relief of vaginal leucorrhœa.

The glycerite of starch (plasma) is an excellent vehicle for the application of astringents to the eye, and is much employed by ophthalmologists for this purpose. Glycerin is used by otologists to soften cerumen, to entangle insects which have entered the ear, to diminish the secretion of pus, and to relieve the morbid state of the auditory canal in cases of otorrhœa.

Collodium.—Collodion. Is a slightly opalescent liquid, of a sirupy consistence. By long standing it deposits a layer of fibrous matter, and becomes more transparent. This layer should be reincorporated, by agitation, before the collodion is used. When applied, it should form a colorless, transparent, flexible, and strongly contractile film.

Collodium Flexile.—Flexible collodion. (Collodion, 920 grm.; Canada turpentine, 50 grm.; castor-oil, 30 grm.)

Liquor Gutta-Perchæ.—Solution of gutta-percha. (Gutta-percha, nine parts; carbonate of lead, ten parts; commercial chloroform, ninety-one parts.)

ACTIONS AND USES.—These solutions, when applied to the integument, evaporate, leaving a transparent film or coating impervious to air and moisture. In drying, collodion contracts energetically, and may indeed produce such a degree of constriction as to cause pain, and to render the part bloodless. Flexible collodion contains turpentine and castor-oil, which confer the property of flexibility, while they do not impair the impermeability of the film. The solution of gutta-percha has properties similar to flexible collodion.

These solutions are employed to protect exposed parts from the contact of air, to secure primary union of incised wounds, to cause resolution of inflamed parts by mechanical pressure, etc.

Some cases of *chronic tubercular and squamous skin-diseases* are much improved by coating them with the gutta-percha solution. Previous to the application of the solution all scales should be removed. Excellent results have been obtained in *herpes zoster* by a thick coating of the flexible collodion or the gutta-percha solution: the pain is relieved, the vesicles aborted, and the duration of the disease shortened. As this is a self-limited disease, there must remain a suspicion of *post hoc* rather than *propter hoc*. *Erysipelas*, especially of the traumatic variety, is, at least, much relieved as regards the local symptoms by a thick coating of flexible collodion, but there is no evidence that it actually shortens the duration of the disease. *Burns to the first degree* are greatly benefited by the same application; it prevents contact of the air, and allays the irritation and pain. When, however, there is much exudation, or sloughing takes place, an impermeable coating adds to the distress.

Collodion has been used without much success in *small-pox*, to hinder the development of the pustules. *Small boils, carbuncles, nævi*, and even superficially placed *aneurisms*, may be so compressed as to arrest the local inflammation or to cause coagulation of the blood. *Orchitis* may be treated by a coating of collodion, instead of strapping. When the mechanical effects of the collodion are to be obtained, successive layers must be applied.

Fissures of the nipples are best treated by flexible collodion or gutta-percha solution. The fissures are carefully wiped dry, well approximated, and then thoroughly coated. Nipples that are retracted may be made more prominent by surrounding them, after being well drawn out, with a thick layer of collodion so placed that on contracting it will pucker the skin of the areola.

Collodion has been used with success as a means of compression in *umbilical hernia, spina-bifida, varicocele*, etc.

Chondrus.—*Chondrus crispus.* Irish moss.

Cetraria.—*Cetraria Islandica.* Iceland moss.

Decoctum Cetrariæ.—Decoction of Iceland moss.

Composition.—The principal constituent of chondrus is a mucilage, which, when dry, is horny, but swells up in water, forming a jelly. Cetraria contains about seventy per cent of a starch (lichen-starch), a decoction of which gelatinizes on cooling. In addition to this starch cetraria contains a bitter principle (cetrarin), and a peculiar acid (licheno-stearic acid).

These lichens are used only for the production of diets for the sick. They were formerly supposed to possess some peculiar virtues which rendered them serviceable to pulmonary invalids. As articles of food, they have a very low position as regards nutritive value. The decoction of cetraria may be used as a stomachic tonic, containing as it does a bitter principle ; but it is only to be prescribed when the more efficient remedies are not well borne.

Chondrus may be made into jelly or *blanc mange*, in the same way as gelatin is now prepared for this purpose. Neligan gives the following recipe for the preparation of a jelly from chondrus : Chondrus, washed and macerated, thirty grains ; spring-water, a pint ; boil down to one half and strain with expression, and add to the strained liquor four ounces of white sugar, one ounce of gum-acacia, and thirty grains of powdered orris-root ; heat to dryness with a gentle temperature, stirring constantly so as to obtain a pulverulent mass, to which three ounces of arrow-root are to be added by trituration. A jelly is prepared with this powder by rubbing up a teaspoonful of it with a little cold water, and then pouring a cupful of boiling water on it.

Acacia.—Gum-arabic. A gummy exudation from *Acacia vera*, and other species of *Acacia*.

Mucilago Acaciæ.—Mucilage of gum-arabic.

Syrupus Acaciæ.—Sirup of gum-arabic. (Mucilage of acacia, 25 c. c.; sirup, 75 c. c.)

Tragacantha.—Tragacanth. The gummy exudation from *Astragalus gummifer*, and from other species of *Astragalus*.

Mucilago Tragacanthæ.—Mucilage of tragacanth.

Sassafras Medulla.—The pith of the stems of *Sassafras officinale*.

Mucilago Sassafras Medullæ.—Mucilage of sassafras-pith.

ACTIONS AND USES.—These preparations are used as demulcent drinks, in cases of acute inflammation of the stomach and intestines. They are supposed to make a protective coating on the inflamed part, and thus save it from further injury. They are especially indicated when irritating and corrosive substances have been swallowed. They are also frequently prescribed as diet-drinks in fevers and in acute inflammations, in accordance with the supposition that they are not only soothing to the alimentary canal, but are, in a limited sense, foods. As nutrients these gums and mucilaginous substances rank very low, and can by no means take the place of such a food as milk. Furthermore, they are exceedingly apt to undergo fermentation, and to produce flatulent colic and diarrhœa.

Mucilaginous drinks are very frequently taken in catarrhal affections of the bronchial tubes and of the kidneys, with the view to modify the morbid process going on in these parts. It need hardly be stated that such a theory of the utility of demulcents is erroneous. Cough is modified by an influence which is probably reflex, when mucilages are applied to the fauces ; but in no other way can the mucous membrane of the air-passages be affected by such remedies taken into the stomach. As gums undergo digestion in the alimentary canal, it is obvious that they can not act as demulcents on any part of the urinary tract.

The chief use of these remedies is in extemporaneous prescriptions, to hold insoluble medicines in suspension, and to cover the taste of disagreeable ingredients.

Linum.—Flaxseed. The seed of *Linum usitatissimum*.

Lini Farina.—Flaxseed-meal.

Infusum Lini Compositum.—Compound infusion of flaxseed. (Flaxseed, ℥ ss ; licorice-root, ʒ ij ; boiling water, Oj.) (Not official.)

Ulmus.—Slippery-elm bark. The inner bark of *Ulmus fulva*.

Mucilago Ulmi.—Mucilage of slippery-elm bark.

Glycyrrhiza.—Licorice-root. The root of *Glycyrrhiza glabra.*

Glycyrrhizinum Ammoniatum.—Ammoniated glycerin.

Extractum Glycyrrhizæ Purum.—Pure extract of glycyrrhiza.

Extractum Glycyrrhizæ Fluidum.—Fluid extract of glycyrrhiza.

Mistura Glycyrrhizæ Composita.—Compound licorice-mixture (brown mixture). A simple expectorant containing paregoric, wine of antimony, and spirits of nitrous ether. Dose, ʒ j—℥ ss.

Actions and Uses.—The remedies of this group contain mucilaginous constituents on which their properties depend. They are frequently prescribed as protectives in gastro-intestinal disorders, and as expectorants in bronchial affections.

Poultices.—Flaxseed-meal, powdered slippery-elm bark, and Indian or corn meal, are most frequently used for the preparation of poultices. Wheat-bread and milk are also occasionally employed for the same purpose.

In the preparation of a poultice, the meal is slowly incorporated with hot water, until a mass of the proper consistency is made. The mixture itself should not be applied immediately to the part, for it dries and adheres with considerable tenacity. A piece of washed muslin of quadrangular shape, and of sufficient size, is selected; the hot mass is spread on one end of the muslin, leaving a margin of one inch on three sides; the long end of the muslin is then folded over the mass, and the free margins are stitched or pinned together. If the poultice is not frequently renewed, to prevent drying, some glycerin should be added to the surface which is to remain in contact with the tissues. Laudanum, or other narcotics, may be stirred in with the meal if the relief of pain be desirable.

A *yeast-poultice* consists of brewers' yeast, to which sufficient flaxseed is added to give the proper consistence.

A *charcoal-poultice* differs from an ordinary poultice in having powdered charcoal incorporated with the mass. In order that a charcoal-poultice shall have the proper consistence, the mass should be thin enough to take up a sufficient quantity of charcoal.

Actions and Uses.—A poultice is a means of applying continuous heat with moisture, and of softening the tissues. An afflux of blood takes place to the part, the vessels dilate, the tissues, softened by the combined influence of heat and moisture, permit the easy diffusion of the fluids. If the process of inflammation has begun, or is in progress, the stasis is relieved, the tension of the inflamed part is lessened, and resolution is thus favored; or, if the stage of exudation is reached, the migration and multiplication of the white corpuscles are promoted, and the extrusion of purulent elements facilitated. The accumulation of blood in the neighborhood of the poultice seems to diminish the pressure elsewhere, and thus poultices of large size lower the arterial tension and lessen stasis in internal parts. Poultices relieve the pain of inflamed parts by relaxing the tissues, and thus removing pressure from the sensory nerve-filaments. The impression thus made on the peripheral nerve-endings is transmitted to the center and reflected over internal organs. It is within the range of everybody's personal experience that warm, moist applications relieve pain in internal and distant parts which have no anatomical connection with the integument to which the applications are made.

Poultices have, therefore, a local and a systemic effect. Their therapeutical uses are based on this conception of their physiological actions. They are prescribed to relieve the tension and to promote resolution or suppuration in *boils, carbuncles*, and other *superficial inflammations*, to hasten the healing of *irritable ulcers*, to favor the separation of *gangrenous sloughs*, etc. Foul-smelling wounds requiring the use of poultices are best treated with the yeast or charcoal poultice.

Unquestionable benefit is derived from the application of hot poultices externally in *acute faucial inflammations*, in *pneumonia, pleuritis, pericarditis, hepatitis, peritonitis*, etc.

The application of poultices sometimes degenerates into abuse. If too long continued, the skin becomes white, wrinkled, and sodden; small abscesses or boils form, and the vessels of the parts very slowly regain their tone. If kept too long in contact with wounds or ulcerated surfaces, the granulations become pale and flabby, and the healing process is retarded. Applied indiscreetly to inflamed joints, they may promote suppuration, and thus permanently injure these structures. If kept long in contact with a large extent of surface, they will lower the general tone and vigor of the system, depress the systemic circulation, exhaust the irritability of the vaso-motor nerves, and thus seriously embarrass the reparative process, if not wholly prevent repair.

APPENDIX.

Equivalents of Weights and Measures.

From 1 Troy Ounce down.

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.
480 [1 ℥	31·103	504·8	240 [4 ʒ	15·551	252·4
478·4	31	503·1	231·5	15	243·4
475·4	30·805	500	228·2	14·786	240
463	30	486·9	218·75 [½ av. oz.	14·175	230·1
456·4	29·573	480	216·1	14	227·2
450	29·159	473·3	210	13·607	220·9
447·5	29	470·7	200·6	13	211
437·5 [1 av. oz.	28·350	460·1	199·7	12·938	210
432·1	28	454·4	185·2	12	194·8
427·9	27·724	450			
420 [7 ʒ	27·214	441·7	180 [3 ʒ	11·663	189·3
416·7	27	438·2	171·1	11·090	180
401·2	26	422	169·8	11	178·5
399·3	25·876	420	154·3	10	162·3
390	25·271	410·2	150	9·719	157·8
385·8	25	405·7	142·6	9·241	150
380·3	24·644	400	138·9	9	146·1
370·8	24·028	390	123·5	8	129·8
370·4	24	389·5			
360 [6 ʒ	23·327	378·6	120 [2 ʒ	7·775	126·2
354·9	23	373·3	114·1	7·393	120
342·3	22·180	360	109·37 [¼ av. oz.	7·088	115·9
339·5	22	357·1	108	7	113·6
330	21·383	347·1	100	6·480	105·2
324·1	21	340·8	95·1	6·161	100
313·8	20·331	330	92·6	6	97·4
308·6	20	324·6	80	5·184	84·1
			77·2	5	81·1
			76·1	4·928	80
			61·7	4	64·9
300 [5 ʒ	19·440	315·5	60 [1 ʒ	3·888	63·1
293·2	19	308·4	57	3·696	60
285·2	18·483	300	54 [⅛ av. oz.	3·544	57·5
277·8	18	292·1	47·5	3·080	50
270	17·495	284	50	3·240	52·6
262·3	17	275·9	46·3	3	48·7
256·7	16·635	270	42·8	2·772	45
246·9	16	259·7	40	2·592	42·1
			38	2·464	40
			33·3	2·156	35
			30·9	2	32·5

Equivalents of Weights and Measures.—(*Continued.*)

Continuation of Table of Equivalents, from 1 Troy Ounce down.

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims.
30 [½ ʒ	1·944	31·6
28·5	1·848	30
23·8	1·540	25
20	1·296	21
19	1·232	20
15·4324	1	16·23
15	0·972	15·9
14·3	0·924	15
14	0·907	14·7
13·3	0·862	14
13	0·842	13·7
12·4	0·801	13
12	0·775	12·6
11·4	0·739	12
11	0·713	11·6
10·5	0·678	11
10	0·648	10·5
9·5	0·616	10
9	0·583	9·5
8·6	0·554	9
8	0·518	8·4
7·7	0·5	8·1
7·6	0·493	8
7	0·454	7·4
6·7	0·431	7
6	0·389	6·3
5·7	0·370	6
5	0·324	5·3
4·8	0·308	5
4	0·259	4·2
3·8	0·246	4
3	0·194	3·2
2·9	0·185	3
2	0·130	2·1
1·9	0·123	2
1	0·065	1·0517
0·9508	0·06161	1

Equivalents of Weights from 5 Grains down.

Grammes.	Grains.	
	In decimal fractions.	In common fractions (approximate).
0·324	5	5
0·291	4·5	$4\frac{1}{2}$
0·259	4	4
0·226	3·5	$3\frac{1}{2}$
0·194	3	3
0·162	2·5	$2\frac{1}{2}$
0·130	2	2
0·097	1·5	$1\frac{1}{2}$
0·065	1	1
0·061	0·94	$\frac{15}{16}$
0·060	0·93	$\frac{9}{10}$
0·057	0·88	$\frac{7}{8}$
0·053	0·82	$\frac{13}{16}$
0·050	0·77	$\frac{4}{5}$
0·049	0·76	$\frac{3}{4}$
0·045	0·69	$\frac{11}{16}$
0·040	0·62	$\frac{10}{16}$
0·036	0·56	$\frac{9}{16}$
0·032	0·5	$\frac{1}{2}$
0·028	0·43	$\frac{7}{16}$
0·025	0·39	$\frac{2}{5}$
0·024	0·37	$\frac{3}{8}$
0·020	0·31	$\frac{5}{16}$
0·016	0·24	$\frac{1}{4}$
0·012	0·18	$\frac{3}{16}$
0·008	0·12	$\frac{1}{8}$
0·004	0·06	$\frac{1}{16}$
0·0032	0·05	$\frac{1}{20}$
0·0027	0·04	$\frac{1}{25}$
0·0022	0·033	$\frac{1}{30}$
0·0018	0·028	$\frac{1}{35}$
0·0016	0·025	$\frac{1}{40}$
0·0013	0·020	$\frac{1}{50}$
0·0011	0·017	$\frac{1}{60}$
0·0010	0·015	$\frac{1}{64}$
0·0006	0·010	$\frac{1}{100}$
0·0005	0·008	$\frac{1}{125}$
0·0004	0·007	$\frac{1}{150}$
0·0003	0·005	$\frac{1}{200}$
0·0002	0·003	$\frac{1}{300}$
0·0001	0·0015	$\frac{1}{400}$

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ABDOMINAL PLETHORA:

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Cathartics, saline, 749; resin-bearing, 753; and hydragogue purgatives, 764.

Saline Mineral Waters, 229, 233; especially Saratoga, Vichy, and the purgative saline generally.

ABORTION:

Aurum, 297. The chloride, to avert the tendency to habitual abortion.

Cornutine, 500. To increase uterine action when required.

Opium, 641. To check uterine action, and *Ergot*, 500, *Hydrastinine*, 191, and *Viburnum*, 365, to restrain hæmorrhage.

Abortifacients, ergot, savine, rue, aloes, picrotoxine, apiol, pilocarpus, colocynth, the hydragogue cathartics, etc., all dangerous to life when used in sufficient quantity to produce abortion.

ABSCESS:

Belladonna plaster, 523. *Emplastrum ammoniaci cum hydrargyro*, 278. *Leeches*, 814. *Silver Nitrate* in nitrous ether applied over inflamed area and adjacent region to abort inflammation, 304, and ointments or powder of *Iodol*, 274, and *Iodoform*, 271, and iodoform substitutes, *Loretin*, 275, *Nosophen*, 276, *Europhen*, 276, *Aristol*, 277. *Tincture of Iodine* as a counter-irritant, and as an antiseptic injected into the sac of an abscess, 262. *Carbolic Acid*, 383, *Salicylic Acid*, 400, *Resorcin* and *Boric Acid*, 420, for antiseptic dressing. *Sulphides*, 249, gr. ¼ every few hours to abort abscess, or hasten the formation and extrusion of pus. *Potass. permangan.*, 157, as a deodorant and germicide. Also *Methylene* blue, 414, *Naphtalin*, 415, for local use.

ACIDITY:

Mineral Acids, 115, before meals. Acid fermentation, with vomiting of pasty matter, *sulphurous* acid, 247. During meals an acid wine (Rhine). For immediate relief, *alkalies* after meals, 221. The frequent use of alkalies enhances the mischief. *Lime-water*, 223. *Ammonium Carbonate*, 237. *Alkaline Mineral-waters*, 229. *Tannic Acid*, 343, in pill-form—♏ j glycerin to gr. iv of tannin. *Carbolic Acid*, 383, stops fermentation and eructations. *Bismuth*, 163, with carbolic acid, gives excellent results. The purified black *Mangani Dioxidum*, 156, and *Silver Oxide*, 301, are serviceable, acting as local sedatives and preventing acid fermentation. *Lead Acetate*, 313, *Kino*, 343, and *Nux Vomica Tincture*, 482, act in the same way, and rather remove the causes than affect the acidity directly.

ACNE:

Phosphorus, 136. Even more effective and safer are the hypophosphites and phosphates. *Arsenic*, 174; sometimes beneficial, but on the whole disappointing. *Bismuth*, 164, is an excellent topical application when there are heat and redness. *Sublimed Sulphur*, 249, applied as a powder to the eruption is one of the best applications. *Sulphides*, 250, in solution, *Ichthyol*, 350, a sulphur compound useful both internally and externally; also iodoform substitutes, *Nosophen*, 276, *Aristol*, 277, and others. *Alkaline lotions*, when the skin is greasy and the sebaceous follicles full, are useful; for example, *liquor potassæ* in rose-water, 225. Lotions of *corrosive sublimate*, 294. *Glycerin*, 817, internally.

ADYNAMIA:

Alcohol, 576, is serviceable when it improves the appetite and digestion, when the tongue becomes moist, and when delirium subsides under its use. Brandy is the best form when bowels are relaxed; whisky when there is constipation. A wine of good body and high bouquet in the weakness of sedentary occupations. *Aliment*, 68, 73, beef, milk, cod-liver oil. *Bitters*, especially *calumba* and *hydrastine*, 190, as a substitute for quinine. *Eucalyptus*, 187, for malarial adynamia, but especially the alkaloids of cinchona, notably *quinine*, 201, gr. ij—gr. v. *ter in die*. *Iron*, 147, to stimulate digestion and promote blood formation, with manganese. Chalybeate springs, 161. *Ferratin*, 153, an albuminous compound of iron. *Nux Vomica Tincture*, 482, with capsicum in the case of inebriates. *Coca*, fluid extract, 561, prevents waste, and favors constructive metamorphosis.

AFTER-PAINS:
Chloral, 617, one of the most efficient remedies, but considerable doses necessary. *Camphor*, 548, effective, with or without morphine. *Gelsemium*, 675, also stops after-pains, but as large doses are necessary, safer remedies are preferable. *Morphine* and *atropine*, 583, subcutaneously or by the stomach, very certain to relieve. *Cimicifuga*, 522, affords some relief.

ALBUMINURIA:
Milk cure, 58; especially buttermilk, 60. *Iron*, 152. Basham's *Mistura Ferri et Ammonii Acetatis*, 152, and the purgative *chalybeate waters*, 161, for the anæmia. *Arsenic*, 175, for the interstitial changes in kidneys. *Alkaline diuretics*, 219. *Gallic acid*, 344, especially Aitken's formula to restrain loss of albumen. *Oxygen*, 367. *Gold and Sodium Chloride*, 297, in the chronic forms. *Nitro-glycerin* and *Nitrites*, 711, for high vascular tension. *Pilocarpine*, 683. *Digitalis*, 513, when quantity of urine much lessens. *Oxalic Acid*, 245, is suggested by its selective action. *Lactate of Strontium*, 327, *Salts of Uranium*, 329, in chronic forms; also *Oil of Erigeron*, 184, *Terpin Hydrate*, 782, renal stimulants.

ALCOHOLISM:
Bromides, 652, especially for the "horrors," in drachm doses. *Capsicum*, 788, for its stomachic tonic and hypnotic qualities. *Chloral*, 617, very efficient in the acute form, but caution is required in cases with weak heart and in old drunkards. *Opium*, 640, cautiously, and especially with belladonna, 644. *Zinc Oxide*, 319, for the chronic state, with piperine or capsicum. *Cinchona*, 207, especially the C. Rubra, fluid extract. *Lupulin*, 646, fluid extract with capsicum; good substitute for alcoholic stimulants. *Picrotoxin*, 491, for the muscular tremors. *Nux Vomica*, 484, nerve and stomachic tonic. *Pilocarpine*, 683, very effective in acute attacks to induce sleep.

AMAUROSIS:
Strychnine, 484, hypodermatically, curative in functional disease caused by tobacco, alcoholic excess, etc. *Pilocarpine*, 683, and also *Picrotoxin*, 491.

AMENORRHŒA:
Aconite, 715, for sudden depression due to cold. *Aloes*, 758, when due to anæmia and torpor. *Iron*, 151, when anæmia is the cause; may be given with nerve-stimulants, as *nux vomica*, *chalybeate waters*, 161. *Apiol*, 794, and *Hydropiper*, 795, when there is functional inactivity of ovaries, preceded by a chalybeate course, by aloes, apiol being given just before the period for several days. *Arsenic*, 175, as a reconstituent, combined with iron. *Gold and Sodium Chloride*, 297, a stimulant of the menstrual function; also, *Oxalic Acid*, 245. *Asafœtida*, 551, for the nervous disturbance and as an ovarian stimulant. *Electricity*, 470, faradic and static; very efficient to start the flow when suitable preparation has been made. *Ergot*, 501, is useful when plethora exists. *Rue*, 796, and *Savin*, 797, are active stimulants, to be given with great caution. *Pulsatilla*, 722, used under the same circumstances as aconite in sudden arrest of flow. *Permanganate of Potassium* and *Salts of Manganese* are the most effective stimulants of the menstrual flow, 158.

ANÆMIA:
Compressed Air, 99. *Oxygen*, 348. *Iron*, 146. *Ferratin*, 153, *Homogalol*, 154, *Hæmol*, 154, mild preparations as substitutes for iron salts. *Arsenic*, 175, an adjunct of iron, or when the latter can not be borne. *Pepsin* and *Pancreatin*, 106, to aid the primary assimilation. *Lacto-phosphate of Lime*, 134, a material needed in the anæmia of lactation and of suppuration. *Manganese*, 156, of use when associated with iron. *Galvanization*, 469, central, and general faradization, to stimulate the functions of organic life. *Wines*, 581, especially wines with good body. *Red Marrow of bone*, 436.

ANÆSTHESIA:
Magnetism, 464, and *Metallotherapy*, 331, for the hysterical state, and for other forms, the electric brush, 468, and *Strychnine*, 483.

ANÆSTHETICS:
Rules for administration, 603. *Morphine*, subcutaneously by the method of Bernard, 602; facilitates the inhalation, lessens the dangers, and prolongs the anæsthetic stage with a less quantity of the anæsthetic. *Whisky*, 602, administered before inhalation, sustains the heart and prolongs the narcosis. Means of restoration, 604, depressing head, drawing out tongue, artificial respiration, inhalation of ammonia, or intravenous injection of the same, faradization of chest-muscles, electro-puncture of the heart, etc.

ANEURISM:
Aliment, 54, denutrition-cure. Tufnell's plan, 56. *Barium Chloride*, 242, acts by raising the arterial tension, and has been used successfully. *Iodides*, 258, in full doses, relieve pain, and promote coagulation of blood in the sac. *Acetate of Lead*, 301, depresses the heart and raises the arterial tension. *Veratrum Viride*, 719, slows the circulation, and thus facilitates coagulation in the sac. *Aconite* and other arterial sedatives act similarly, but their action must be aided by a proper diet and absolute recumbency. *Ergot*, 499, especially ergotin subcutaneously, has been very effective. *Galvano-puncture*, 471, has but rarely succeeded.

ANGINA PECTORIS:
  Amyl Nitrite, 706, by inhalation, affords prompt relief in cases characterized by elevated arterial tension, but must be used with caution when arteries are atheromatous and heart is fatty. *Nitro-glycerin*, 709, acts similarly but more slowly, and is more manageable. *Arsenic*, 173, in full doses, is very efficient as a means of prevention. *Ether*, 593, in small quantity by inhalation, may abort a mild attack, hypodermatically, in the worst cases.
ANTIDOTES:
  For the Mineral Acids, 112. Alkalies, soda, lime-water, soap, and protectives, as oil, mucilage, etc. For the systemic depression, alcohol, opium, and especially carbonate of ammonia.
  For Phosphorus, 128. Emetic of sulphate of copper, French turpentine, or old, unrectified turpentine, hydrated magnesia, laxatives. transfusion, and especially solution of *Permanganate Potassium*, 130. Oils and fats aid the absorption of phosphorus, but mucilaginous protectives are useful.
  For Arsenic, 166. Hydrated sesquioxide of iron, dialyzed iron. hydrated magnesia, emetics, the stomach-pump; opium and alcoholic stimulants for the systemic depression.
  For the Caustic Alkalies, 212. Diluted acetic acid, vinegar, soap, oil; opium and stimulants for the systemic depression.
  For Barium, 241. Emetics, protectives, hydrated magnesia, tannin, especially diluted sulphuric acid: nitrite of amyl and nitroglycerin to counteract the elevated arterial tension.
  For Sulphurous Acid and *Sulphites*, 246, and the *Sulphides*, 248. Weak acids, chlorine-water, sulphate of iron, common salt, etc.
  For Iodine and its poisonous compounds, 254. Starch is the antidote for iodine; but, as the iodide of starch is not without power, emetics should also be given. Albumen, starch, lime-water, tannin, soap, etc., should be used in poisoning by iodides, and free emesis should be induced.
  For Iodoform, 269.
  For Mercury and its compounds, 281. Albumen, the carbonated alkalies, tannin, lime-water, should be administered freely. Emetics should be given. For the usual systemic symptoms, opium, alcoholic stimulants, etc.
  For Gold and its Chlorides, 296. Same as for mercury.
  For Silver, 298. Common salt freely, albumen, tannin, and emetics.
  For Copper, 306, and *Zinc*, 317. Albumen, tannin, lime-water, soap, oil, and mucilage; and the usual systemic remedies.
  For Lead, 311. Diluted sulphuric acid, alum, Epsom salts, milk; emetics and purgatives; iodides and bromides to secure elimination.
  For Antimony, 322. The vegetable astringents, tannin, albumen, oil, mucilage, and opium and stimulants to counteract the depression.
  For Nux Vomica and its Alkaloids, 476. Chloral, ether and chloroform, gelsemium, bromide of potassium, are the physiological antagonists; tannin is a chemical antidote.
  For Picrotoxin, 489. The physiological antagonists and the antidotes are the same as for strychnine.
  For Ergot, 492. The caustic *alkalies*, aconite, but especially amyl nitrite.
  For Digitalis, 507. Aconite, saponaria, amyl nitrite, and nitro-glycerin, are the physiological antagonists; tannin, sulphate and chloride of iron, are chemical antidotes.
  For Belladonna and its alkaloid *Atropine*, 523. Opium or morphine, physostigma or eserine, and pilocarpine, are the most efficient antagonists. The caustic alkalies destroy the active principle, but the available chemical antidotes are tannin, compound solution of iodine, charcoal, etc.
  For Stramonium, *Hyoscyamus*, and *Duboisia*. The antagonists and chemical antidotes are the same as for belladonna.
  For Camphor, 545. Caffeine, the arterial sedatives, etc.
  For Cannabis Indica, 555. Caustic alkalies, strychnine, faradic electricity.
  For Chloroform. By the stomach, 595. The stomach-pump, oil and mucilage, atropine, faradism, artificial respiration, and cold affusion. By inhalation, 604. Nélaton's method (inversion of the body), drawing out the tongue, artificial respiration, faradism, ammonia by inhalation and intravenous injection, amyl nitrite by inhalation, subcutaneous injection of tincture of digitalis, and oxygen, 348, by inhalation.
  For Chloral, 613. Ammonia, atropine, galvanism, and heat, to overcome the cardiac depression. Strychnine is the antagonist of Liebreich, but its range is limited. Eserine, to a slight extent, is physiologically opposed.
  For Opium, 627. The stomach-pump, or emetics (bicarbonate of sodium, followed by tartaric acid, has acted favorably); cold affusion, faradization, and artificial respiration, when the respiration flags; belladonna, or atropine subcutaneously, has acted favorably in numerous cases; caffeine injected, or black coffee.
  For Conium, 663. Chemically the caustic alkalies and tannic acid are antidotes; emetics or the stomach-pump, cold affusion, artificial respiration. Atropine and strychnine, subcutaneously, to counteract the respiratory depression.
  For Curara or Woorara, 667. Caustic alkalies and tannin act chemically; artificial respiration is of the highest importance; atropine and strychnine counteract the

respiratory failure. Cold affusion and emetics, or the stomach-pump, are necessary.

For Gelsemium, 672. Chemically caustic alkalies and tannic acid. Emetics, warmth, ammonia, faradization of chest-muscles, artificial respiration, and morphine, subcutaneously, are the important measures.

For Pilocarpus, 679. The persalts of iron and the salts of metals are chemically antidotal. Atropine is, in a very complete degree, the physiological antagonist; cardiac stimulants, as ammonia and alcohol, antagonize the cardiac depression.

For Physostigma, 687. The vegetable astringents and tannin, chemical antidotes. Physiological antagonists are, atropine to considerable extent—chloral, apparently, more completely. Faradization of chest-muscles and artificial respiration are important measures. Emetics should not be omitted.

For Tobacco or Nicotine, 692. Emetics or stomach-pump. Tannin, compound solution of iodine, *potassium permanganate*, 157, chemical antidotes. Ammonia, brandy, atropine, and strychnine to overcome failure of respiration; also, artificial respiration, cold affusion.

For Hydrocyanic Acid and Cyanide of Potassium, 698, 702. Cold affusion to the spine, artificial respiration, and the injection of atropine, are the best expedients. Emetics should be given if there is time.

For Amyl Nitrite and Nitro-glycerin, 704, 707. Ammonia, cold affusion, and artificial respiration, *strychnine* and *atropine* subcutaneously, also ergot, a true physiological antagonist.

For Aconite and Veratrum Viride, 711, 716. Ammonia, alcohol, artificial respiration, heat, atropine, or morphine, subcutaneously; also digitalis.

For Agaricin and Muscarine, 726. A complete antagonism exists between atropine and muscarine; also, digitaline and eserine are antagonists. Potassium permanganate, 157, antidotal to organic alkaloids.

For Chlorine, 370. Ammonia for the gas, and albumen for the solution.

For Carbolic Acid, 375. Saccharate of lime, or lime, is a chemical antidote. Oils and glycerin *must not be given*, but vegetable demulcents used freely. Atropine is a physiological antagonist of great value. Emetics should be used, and diluents.

For Salicylic Acid and Resorcin, 390, 401. Arterial and respiratory stimulants prevent the cardiac depression, especially atropine.

For the Hydragogue Cathartics, 764. Demulcents, opium, and stimulants.

For Turpentine, 776. Emetics, diluents, and demulcents. Opium is the most important remedy to counteract the local irritation and the cerebral effects.

For Savin and Cantharides, 796. Emetics and demulcents. Opium to counteract the depression and local inflammation; also, stimulants and atropine for the cardiac depression.

ANTIPYRETICS:

Quinine, 204, first in importance, but must be given in full doses. *Eucalyptus*, 186, useful in chronic malarial poisoning. *Digitalis*, 511, chiefly useful as an adjunct to quinine. *Salicylic Acid*, or *salicylates*, 396, active and certain antipyretics. *Antipyrin*, 412, *Salol*, 408, *Acetanilid*, 425, *Resorcin*, 404, *Thallin*, 406, *Naphtol*, 416, *Asaprol*, 417, *Phenacetin*, 418. *Benzoates*, 422, are the more important of the antiseptic antipyretics. *Cold Baths*, 83, 84, the most powerful means of lowering temperature. *Pilocarpine*, 688, reduces fever after a preliminary stimulation. Of lesser importance are *Aconite*, 713, *Gelsemium*, 674, and *Phytolacca*, 725.

ANTISEPTICS:

Carbolic Acid, 375, and the other members of the group in the same division, including those mentioned above, and classed together as *Antiseptics*, 365 *et seq.*

APHONIA:

Atropine, 527, is curative in hysterical cases, if given to induce some obvious constitutional symptoms. *Nitric Acid*, 118, is very effective in the hoarseness of singers, when the aphonia is reflex (cold, indigestion, etc.), and in fatigue of vocal cords. *Electricity*, 467, by an intra-laryngeal electrode, usually cures paresis of the vocal cords.

APHTHÆ:

Bismuth, 162, in powder directly to the ulcers. *Coptis*, 180, the infusion as a topical application. *Potassium Chlorate*, 217, 224, probably the most effective remedy, locally, and by the stomach; full doses are necessary. *Iodoform*, 263, with or without *Tannin*, 264, and *Iodol*, 274. *Naphtalin*, 417, an excellent topical application. *Quinine*, 200, highly useful as a tonic. *Muriatic Acid*, 114, a local application, to ulcers, formerly more employed than at present. *Sulphurous Acid*, 246, well diluted, in the form of spray. *Carbolic Acid*, 377, pure, applied to ulcers, an anæsthetic and alterant. *Resorcin*, 404, dusted over affected surface.

APOPLEXY. (See HÆMORRHAGE, CEREBRAL.)

ARTHRITIS, CHRONIC RHEUMATIC:

Alkalies, 217, especially lithium. *Potassium Iodide*, 260. *Cimicifuga*, 522. *Salicylates*, 399; especially in debilitated subjects, *Salicylate of Cinchonidine*, 397. *Salicin*, 389. *Salol*, 408. *Acetanilid*, 426. *Antipyrin*, 412. *Phenacetin*, 418. *Carbolic Acid*, 3 2, by parenchymatous injection. *Arsenic*, 173, persistently used in small doses. *Cod-liver Oil*, 126, with or without the phosphates.

ASCARIDES :
Quassia, 181, also *Eucalyptus*, 186, an infusion as a rectal injection, or by irrigation of the bowel. *Carbolic Acid*, 282, is an efficient but unsafe parasiticide when injected in the rectum. *Iron*, 147, the sirup of the iodide, by the stomach to prevent reproduction, and the tincture by rectal injection. *Santonin*, 772, at night, with or without calomel, and a laxative in the morning. *Enema Aloës*, 769. *Hydrocyanic Acid*, 701, for lumbricoides. *Salicylic Acid*, 295, by enema and by stomach. *Myrtol*, 429, and *Cajeput Oil*, 430.

ASCITES :
Copaiba Resin, 784, has proved very efficient as a diuretic. *Pilocarpine*, 683, very serviceable when given to produce free diaphoresis. *Jalap*, 759, in the form of the compound powder, most useful as a hydragogue cathartic. *Elaterium*, 767, also a hydragogue of great power ; must be given cautiously, and not at all when gastro-intestinal irritation exists. Remedies are more active when aided by a *milk-diet*, 59, or by *dry diet*, 54.

ASTHMA :
Air, compressed, 99. *Oxygen*, 367, pure or diluted, by inhalation. *Amyl Nitrite*, 706, by inhalation, or *Nitro-glycerin*, 710, by the stomach. *Arsenic*, 173, by the stomach, as a prophylactic, or by smoking in cigarettes. *Bromides*, 656, relieve in purely spasmodic asthma, but soon lose their effect ; also *Bromoform*, 660. *Chloral*, 617, may arrest the paroxysms, but danger of chloral habit. *Chloroform*, 605, by inhalation, dropped on warm water, relieves, but a habit is quickly formed. Last two remedies are dangerous in weak heart. *Ether*, 605, is safer and equally efficient by inhalation. *Paraldehyde*, 585. *Quebracho*, 732, a valuable remedy in most forms of dyspnœa. *Hyoscine*, 540. *Belladonna*, 527, in pastilles with stramonium and other narcotics, gives temporary relief, but *Atropine*, hypodermatically, is more efficient. *Morphine*, 644, and *atropine* subcutaneously, give more decided and lasting relief than any other remedies. *Grindelia*, 723, is a most useful remedy, next in value as a means of immediate relief to morphine and atropine. *Iodide of Potassium*, 259, in full doses, succeeds remarkably in some cases. *Ethyl Iodide*, 267, and *Ethyl Bromide*, by inhalation. *Quinine*, 207, as a tonic after the acute symptoms and as a prophylactic in the interval. *Strychnine*, 484, is indicated when there is weakness of respiratory muscles. *Pyridine*, 417, a new and effective remedy, by inhalation. *Galvanization*, 439, of the pneumogastric and cervical sympathetic relieves the spasmodic difficulty of breathing, and sometimes effects a cure, and *faradization* of the chest-muscles has lately been reported successful in effecting a cure. *Tartar Emetic*, 324, and *Lobelia*, 697, carried to slight nausea in cases of deficient secretion of bronchial mucus. *Pilocarpus*, 683, subcutaneously in spasmodic asthma.

ASTIGMATISM :
Atropine, 531, a weak solution to facilitate examination. *Hyoscine*, 540, *Duboisine*, 542, a substitute. *Eserine*, 691, in some cases.

ATHEROMA OF THE VESSELS :
Arsenic, 173, indicated when eyes are puffy, breathing short, and ankles swollen. *Phosphorus*, 135, in minute doses for the weakness and mental failure associated therewith, with or without *Cod-liver Oil*, 126, which may also be advantageously combined with phosphates and hypophosphites. *Ammonium Carbonate*, 238, to dissolve thrombi. *Quinine*, 207, is of great service administered in a full dose daily for a time. The *Iodides*, 258, persistently administered, in a high degree effective.

BED-SORES :
Alcohol, 577, a wash to skin. *Alum*, 337, with tincture of camphor and whites of eggs, a good topical application *Bismuth Salicylate*, 164. *Resorcin*, 404, in form of powder. *Copaiba*, 784, and *Castor-Oil*, equal parts, but *Naphtol*, 416, *Methylene Blue*, 413, *Tannigen*, 349, *Dermatol*, 164, local applications, astringent and antiseptic. A galvanic couplet, zinc and silver, connected with a copper wire, has been used with success, 470.

BILIARY CALCULI. (See CALCULI.)

BILIOUSNESS :
Acids, Mineral, 115, before meals in acid indigestion. Hydrochloric acid and pepsin after meals in atonic dyspepsia. *Alkalies*, and their laxative salts, 216, and *Alkaline Mineral Waters*, 229, 234, when the uric acid is in excess. *Sodium Phosphate*, 139, especially useful. *Aloes* and the resin-bearing cathartics, 756, *Cholagogues*, so called, *Euonymin*, 721, *Iridin*, 763, *Baptisin*, 764, etc., to promote biliary evacuations. *Calomel* and blue-pill, 284, in small quantity as laxatives merely. *Ammonium Chloride*, 237. *Manganese*, 156, in gouty subjects *Ammonium Iodide*, or iodine, 257, in the biliousness of the malarial cachexia. *Hydrastis*, 190, *Stillingia*, 357, and the bitters, also *Tincture of Nux Vomica*, 482, after the action of saline or resinous cathartics. *Milk-Diet*, 59, 65, *Whey-Cure*, 59, *Koumiss*, 59, of high importance.

BITES OF VENOMOUS SNAKES :
Ammonia, 240, *Bromine*, 372, locally to the wound. *Intravenous Injection of Ammonia*, 26. *Potassium Permanganate*, 157, *Alcoholic Stimulants*, 576. *Chlorinated Lime*, 370.

BLADDER, CATARRH OF :
Alkalies, 218, after meals, when urine is acid. *Ammonium Benzoate*, 422, when urine is al-

kaline. *Copaiba*, 784, *Cubebs*, 786, *Juniper*, 789, and other urino-genitals, are useful, but liable to damage kidneys. *Cantharides Tincture*, 790, very efficient in small doses. *Magnesium Borotartrate and Borocitrate*, 421, have proved highly useful. *Eucalyptus*, 187, and *Turpentine*, 781. *Quinine*, 207, very beneficial when there is septicæmic fever. *Salicylic Acid*, 394, *Salol*, 409, *Saccharin*, 418, and other members of the series, have proved effective.

BLADDER, IRRITABILITY OF:
Belladonna, 530, of special utility in nocturnal incontinence, but must be carried to the production of physiological effects. *Cantharides Tincture*, 799, sometimes succeeds remarkably in irritable bladder of women. *Aquapuncture*, 809, often curative. When urine is acid, *Alkalies*, 218; when alkaline, *Ammonium Benzoate*, 422.

BOILS:
Arsenic, 174, long continued for a succession of boils. *Silver Nitrate*, 305, dissolved in nitrous ether, and painted on early, will abort. *Sulphides*, 249, in small doses frequently, either stop formation or push to maturation and discharge of pus. *Sulphurous Waters*, 253, act in same way. *Phosphates*, 140, suitable tonics.

BONE DISEASES; SOFTENING OF BONE:
Lime Carbonate and *Phosphate*, 139, are materials necessary. *Phosphorus*, 135, promotes formation of bony tissue. *Phosphates*, 139, improve tissue formation in general. *Cod-liver Oil*, 124, in combination. *Calcium Chloride*, 223, in strumous subjects. (See also CARIES, RICKETS.)

BREATH, FOUL:
Chlorine-Water, 370, properly diluted. *Carbolic Acid*, 383, in dilute solution, as a mouth-wash, and by the stomach. *Potassium Permanganate*, 159, in rose-water as a mouth-wash. *Benzoic Acid* and *Tincture of Benzoin*, 422, topically and internally.

BRIGHT'S DISEASE:
Milk-Cure, Koumiss, Whey, 59, 61, have been very successful, especially an exclusive skim-milk diet, or a diet composed largely of milk. *Water*, 82, and large draughts of weak alkaline waters. *Potassium Bitartrate*, 218, as lemonade, drunk freely as a diuretic. *Digitalis*, 513, the infusion for dropsy. *Iodide of Potassium*, 258, in cases of chronic kind (especially if there is a syphilitic taint), and in arterio-sclerosis. *Iron*, 152, the tincture of the chloride well diluted, or in Basham's mixture, to stimulate the kidneys and to relieve the accompanying anæmia. *Pilocarpus*, 683, highly useful in many cases of uræmia. *Aurum*, 297, in chronic interstitial nephritis and amyloid kidney. *Cantharides*, 799. *Eucalyptus*, 187, and other urino-genitals, but are doubtful. *Nitro-glycerin*, 709, has proved highly useful when there is increased vascular tension.

BRONCHITIS, ACUTE:
Muscarine, 729, at the onset of the disease may arrest. *Aconite*, 714, in small dose frequently. *Tartar Emetic*, 324, in moderate quantity, with or without morphine. *Nitric Acid* dilute, 118, *Cimicifuga*, 521, an expectorant, may be combined with opium and aconite. *Ammonium Carbonate*, 239, if secretion is viscid and there is depression. *Sanguinaria*, 359, and *Lobelia*, 698, nauseating expectoration, best given with opium. *Terebene* for cough, 781, a valuable remedy. *Morphine*, or *Dover's Powder*, with *quinine*, 642, may abort if given early enough. *Pilocarpus*, 683, often highly useful at the beginning. For mild cases, *Sirup of Squills*, 793, or the compound sirup, with *Paregoric*, makes a useful combination. *Ipecac*, 740, as expectorant. *Apomorphine* and *Apocodeine*, 736.

BRONCHITIS, CAPILLARY:
Iodides, 258, diminish the viscidity of the secretion, and thus lessen one of the chief dangers. *Ammonia Carbonate*, 239, acts similarly, and is indicated when depression comes on. *Ethyl Iodide*, by inhalation, 267, and Terebene. *Serpentaria*, 183, a stimulating expectorant, may be given with ammonia. *Turpentine*, 779, when the capillary circulation languishes. *Terebene*, for cough, 781. *Camphor*, 547, also under the same circumstances. Emetics are highly useful, the *Mercury Subsulphate*, 734, *Alum*, 734, and *Apomorphine*, 736, being the principal. *Pilocarpus*, 683, when there is much secretion. *Pyridine Vapor*, 417.

BRONCHITIS, CHRONIC:
Koumiss, 59, 71, a valuable nutrient. *Cod-liver Oil*, 124. *Iron*, 150, especially the mistura ferri composita. *Ammonium Chloride*, 239, combined with stimulating expectorants, as *Eucalyptus*, 186, or *Serpentaria*, 183, or *Sanguinaria*, 361. The *Iodides*, 258, especially the iodide of ammonium, is serviceable in combination with the expectorants just named. *Morphine*, 638, especially morphine and atropine, 644, or some preparation of opium, is indispensable to quiet cough. *Strychnine*, 484, and the sirup of the phosphate of iron, quinine, and strychnine, is a valuable respiratory stimulant. Strychnine is the best remedy to check the reflex vomiting. Inhalations of *Sulphurous Acid*, in spray or gas, 247, especially Pictet liquid, 374, *Ethyl Iodide*, 267, and gaseous enemata of *Carbolic Acid* and *Creosote*, 379. *Benzoates*, also, 422, are very useful. *Grindelia*, 723, a valuable expectorant, especially when the cough is troublesome. *Copaiba*, 784, and *Cubeb*, 786, useful stimulating expectorants.

BRONCHORRHŒA:
Eucalyptus, 186, *Turpentine*, 779, its derivatives and the stimulating expectorants mentioned under chronic bronchitis. *Carbolic Acid*, 379, internally and by spray.

Grindelia, 723, *Ammonium Carbonate and Chloride*, 239. *Cubeb*, 786, *Copaiba*, 784. *Sulphurous Acid*, spray, 247, and as *Pictet liquid*, 374. *Benzoin*, inhalation, 422. *Terebene*, 781, antiseptic ; eliminated by the lungs. *Oxygen* by inhalation and gas enemata, 379. *Iodides*, 258. *Phosphates* as restoratives, 140.

BURNS AND SCALDS :
Sodium Carbonate, 225, in saturated solution to relieve pain. *Boric Acid*, 420, most useful in Mr. Lister's hands. *Lead Carbonate*, 315, painted on. *Turpentine*, 780, mixed with basilicon-ointment. *Salicylic Acid*, 400. *Carbolic Acid*, 382, one-per-cent solution relieves pain and prevents suppuration. *Collodion*, 819, the flexile for slight burns.

CACHEXIA :
Aliment, 67, of first importance. *Air*, 99. *Massage*, 102. *Oils and Fats*, 124, and oil inunctions. *Iron*, 148, and *Chalybeate Waters*, 161. *Manganese*, 157, especially *Sirup of the Iodide of Iron* and *Manganese*. *Arsenic*, 175. *Phosphates*, 140. The *Simple Bitters*, 181. *Eucalyptus*, 186. *Hydrastis*, 191. *Quinine*, 204. *Nitro-glycerin* to improve nutrition by dilating arterioles.

CALCULI, BILIARY :
Aliment, 66. Starches, sweets, and especially fats, should be avoided. *Alkaline Mineral Waters*, 229, highly useful. *Sodium Phosphate*, 139, persistently used. *Turpentine* and *Ether*, 778, remedy of Durand. For the paroxysms, see COLIC.

CALCULI, RENAL :
Alkalies, 218, 224, when the calculi are compounds of uric acid with potash, and not soda salts. Also, *Alkaline Mineral Waters*, 229, 230, Vichy, Bethesda, etc. *Ammonium Benzoate*, 422, for the solution of phosphatic calculi. Very long continued use of the solvent necessary. *Magnesia Borocitrate*, 420, solvent for uric-acid calculi. *Magnesia Tartroborate*, 421, probably still more efficient.

CANCER :
Arsenic, 176, relieves the pain and retards the growth of carcinoma of the stomach, and also of epithelioma. *Bismuth*, 163, relieves the vomiting in cancer of the stomach ; also, *Carbolic Acid*, 362, especially by the method of parenchymatous injection. *Potassa Chlorate*, 225, *Salol*, 410, *Iodol*, 274, *Naphtol*, 416, and *Terebene*, 781, applied in powder alters the ulcerated surface. *Iodoform* and *Salicylic Acid*, 400, also in powder to the surface of the cancer. *Zinc Chloride* and *Sulphate dried*, 320, are efficient caustics. *Potassa Fusa*, 225, *Chromic Acid*, 815, and *Bromine*, 372, also active escharotics for the destruction of morbid growths.

CARIES :
Cod-liver Oil, 124, to promote constructive metamorphosis. *Phosphates*, 139, and *Lime Carbonate*, 223, furnish needed materials. *Calcium Chloride*, 223, is useful in the strumous cachexia. *Phosphorus*, 134, promotes bone formation. Villatte's solution used to dissolve carious bone.

CATARRH, ACUTE ; COMMON COLD :
Aconite, 714, for the preliminary fever, with *Belladonna*, 527, when secretion is excessive. *Quinine* and *Morphine*, 207, 642, may, at the outset, abort an attack. *Ipecac*, especially the fluid extract, 743, alone or in combination with opium and aconite. *Tartar Emetic*, 324, in minute doses with morphine, is very useful. *Dover's Powder*, 642, at the inception may arrest the attack. *Iodides*, 258, a small dose very frequently, and *Inhalations of Iodine*, 262, and of *Ethyl Iodide*, 266. *Ammonia*, 240, carefully inhaled at the outset of the disease. *Pulsatilla*, 722, acts similarly to aconite, but is contraindicated if gastro-intestinal irritation exist.

CATARRH, BRONCHO-PULMONARY :
Air, compressed, 98. *Alum*, 320, by insufflation. *Aconite*, 714, when attack is recent ; *Belladonna*, 527, when secretion is profuse. *Eucalyptus*, 186, *Hydrastis*, 190, *Sanguinaria*, 341, and *Prunus Virginiana*, 183, after the acute symptoms have subsided. Also, *Cubeb*, 786, *Copaiba*, 784, *Turpentine*, 781, *Terebene*, 781, and *Carbolic Acid*, 379, of great value by inhalation of vapor and spray ; also, *Arseniate of Sodium*, 172, by fumigation.

CATARRH, CHRONIC NASAL :
Alum, 320, in powder by insufflation. *Iodoform* and *Tannin*, 271, also applied in powder by insufflation. *Iodine*, 259, in vapor inhaled ; also *Bromine*, 371, but it must be inhaled very cautiously. *Ethyl Iodide*, by inhalation, 267. *Iodic Acid* and *Iodates*, 265, effective remedies by injection and spray. *Sanguinaria*, 361, the tincture internally and the powder locally. *Cubeb*, 784, in powder by insufflation and troches. Also, *Pyridine*, 417, and *Hydrogen dioxide*, 368.

CATARRH, GASTRIC. (See GASTRIC CATARRH.)

CATARRH, INTESTINAL. (See DYSENTERY and DIARRHŒA.)

CATARRH, GENITO-URINARY. (See BLADDER, CATARRH OF, CYSTITIS, GONORRHŒA, LEUCORRHŒA, PROSTORRHŒA, ENDOMETRITIS, etc.)

CEREBRAL ANÆMIA :
Iron, 148, and *Chalybeate Mineral Waters*, 161. *Galvanism*, 465, by transverse applications. *Phosphorus*, 135, and *Phosphates*, 140, *Quinine*, 207, *Strychnine*, 482, and the cerebral excitants, *Caffeine*, 566, *Guarana*, 567, etc. *Arsenic*, 173, is highly efficient in some hypochondriacal cases ; also, *Aurum*, 297, *Amyl Nitrite*, 705, *Nitro-glycerin*, 709, and *Ammonia*, 239, afford relief in sudden attacks by dilating vessels.

CEREBRAL CONGESTION :
Aconite, 714, *Cold Douche*, 85, alternate hot and cold applications. *Bromides*, 653, highly useful. *Ergot*, 501, *Gelsemium*, 674,

Hydrocyanic Acid, 701, and the arterial sedatives, *Veratrum Viride*, 719, *Digitalis*, 513, etc. *Galvanization* of the cervical sympathetic, 465. *Venesection*, 814, is a suitable remedy in cases threatening rupture of vessels. *Arsenic*, 173, when due to atheroma of vessels. Active *Cathartics*, 766, *Colchicum*, 354, lessen blood-pressure and act by derivation.

CEREBRO-SPINAL MENINGITIS:
Aconite Tincture, 714, carried to arterial depression before exudations. *Ergot*, 501, also for first stage or period of congestion and irritation. *Gelsemium, Fluid Extract*, 674, for same period. *Opium*, 638, is the most effective remedy. *Quinine*, 203, full cinchonism at the onset of the disease. *Cold Baths*, 83, 84, for hyperpyrexia.

CHANCRE. (See SYPHILIS.)
Bromine, 372, *Chromic Acid*, 815, *Nitric Acid*, 119, and *Acid Nitrate of Mercury*, 293, efficient escharotics for the destruction of chancre. *Iodoform*, 271, and *Iodol*, 273, with or without *Thymol*, 428, are excellent applications dusted over sore. *Carbolic Acid*, 382, applied pure in mild cases. *Iron Iodide*, 152, internally in cases of systemic depression, or sloughing phagedæna. *Potassa Chlorate*, 225, in powder, is also an excellent local application. *Aristol*, 277, an iodine compound useful in soft chancre. *Sozoidol*, 277, *Loretin*, 275, in same.

CHILBLAINS:
Turpentine, 781, and still more efficient *Terebene*, 782, *Tincture of Iodine*, 262, *Carbolic Acid*, 382, with iodine and tannin. *Sulphurous Acid*, diluted with glycerin, 247, is an excellent application. *Benzoin Tincture*, 422, the first in value.

CHLOROFORM NARCOSIS. (See ANTIDOTES, NARCOSIS.)

CHLOROSIS:
Arsenic, 175, as an adjunct to, or substitute for, iron. *Oxygen*, 367, inhaled. *Iron*, 148, with or without *Manganese*, 156, or arsenic; with aloes if constipation exist. *Ferratin*, 153, *Hæmol*, 154, mild tonics. *Chalybeate Springs*, 161. *Massage*, 102, oil inunctions, 124, and faradization. *Galvanization*, 465, to central nervous system. *Red-marrow of Bones*, 436, and in some cases the *Thyroid Body*, 435. *Nux Vomica*, or strychnine, 438, stimulates the blood-making organs; may be combined with iron. *Pepsin* and *Pancreatin*, 107, improve digestion.

CHOLERA ASIATICA:
Lead Acetate, 813, an excellent astringent, usually given with opium and camphor. *Camphor*, 546, the saturated tincture. *Carbolic Acid*, 379, with or without iodine. *Chloral*, 616, is highly effective by subcutaneous injection; usually combined with morphine. *Chloroform*, 596, a few drops frequently to stop vomiting, and *Chlorodyne*, 598. *Opium*, 636, especially useful to arrest preliminary diarrhœa. *Calomel*, 289, minute doses will sometimes stop vomiting. *Alcohol*, 575, as iced brandy or champagne to arrest vomiting and stimulate the heart. *Sulphuric Acid*, 116, with opium tincture, an excellent remedy for cholera diarrhœa. *Arsenic*, 172, Fowler's solution with opium, sometimes valuable. *Strychnine*, 482, has been used with success in some epidemics. *Atropine*, 527, to stimulate the heart in cholera asphyxia. *Intravenous Injection of Salines*, 25, in the algid stage, and of *Milk*, 30. *Enteroclysis*, 14, *Hypodermatoclysis*, 23.

CHOLERA INFANTUM:
Aliment, 66, is of the highest importance. See *Poisonous Milk and Cream*, 62, which should be read. *Buttermilk-Cure*, 60. *Carbolic Acid*, 379, with or without bismuth, is very effective. *Bismuth*, 163, is frequently prescribed in an emulsion. *Zinc oxide*, 318. *Calomel*, 287, in minute doses, arrests vomiting. *Copper Sulphate*, 308, is an effective remedy, but only the smallest doses are admissible. *Potassium Bromide*, 651, and the *Cold Bath*, 84, 85, are highly useful in cases characterized by nervous irritability and feverishness. *Ipecacuanha*, 741, is a desirable remedy when the stools assume a dysenteric character. *Brandy*, 575, renders important service in most cases, but full doses are necessary. *Camphor*, 546, is indicated when depression is marked; it may be given in milk. *Silver Nitrate*, 291, beneficial after the acute symptoms. *Opium*, 636, must be given with great caution.

CHOLERA MORBUS:
Morphine and *Atropine*, 636, hypodermatically, the most efficient remedy. *Chloral*, 616, with morphine if cramps occur. *Carbolic Acid* and *Bismuth*, 379, in an emulsion together, are sufficient in mild cases. The remedies for CHOLERA ASIATICA.

CHORDEE:
Camphor, 547, successful if given in sufficient quantity; may be administered with lactucarium. *Bromides*, 657, occasionally give relief. *Cantharides Tincture*, 799, in small dose, is said to be useful. *Morphine and Atropine*, 644, subcutaneously, is the most certain. *Colchicum*, 354, in a nightly dose, will succeed by inducing some nausea. *Tartar Emetic*, 325, will relieve if carried to nausea. *Tobacco, Wine of*, 695, a few drops at bed-hour. *Lupuline*, 646, not powerful.

CHOREA:
Water, 86, cold effusion and cold baths. *Iron*, 150, especially subcarbonate, for the condition of anæmia and amenorrhœa. *Cod-liver Oil*, 121, when the nutrition is poor. *Arsenic*, 173, one of the most certain remedies, but large doses are required, and well borne. *Strychnine*, 484, and especially *Picrotoxin*, 491, in full doses when the nervous element is predominant. *Cim-*

icifuga, 522, useful in some cases, but it is uncertain, and must be *pushed* to get the best results. *Conium*, 665, especially *succus conii*, has been strongly urged by Harley. *Morphine*, 640, in the large doses advised by Trousseau, and *Chloral*, 617, especially at night, are highly useful. *Static Electricity*, 466, has lately been revived. *Magnets*, 464. *Calcium Chloride*, 223, has done good in strumous subjects. *Cannabis Indica*, 556. *Cocaine*, 562, highly effective in some cases.

CIRRHOSIS:

Iodides, 257, with or without arsenic, are useful in the first stage. *Phosphate of Soda*, 140, persistently administered, of real value if commenced early. *Gold and Sodium Chloride*, 297, has seemed to have curative power if given in time. *Arsenic*, 172, also retards if it does not arrest overgrowth of connective tissue. *Stillingia*, 358, and *Hydrastis*, 190, in incipient disease, secondary to intestinal catarrh.

COLIC:

Asafœtida, 551, in the flatulent colic of infants. *Chloroform*, 596, useful in flatulent colic and in hepatic, a few drops frequently; also *Chlorodyne*, 598. *Ether*, 593, 605, internally and by inhalation. *Camphor*, 547, a few drops of the saturated tincture frequently. *Infusum Tabaci*, 694, as an enema, effective but dangerous. *Morphine*, 641, and *Morphine* and *Atropine*, 644, hypodermatically, the most prompt and successful remedy.

COLICA PICTONUM:

Alum, 335, overcomes the constipation with success; may be given with dilute sulphuric acid. *Sulphuric Acid*, 118, very dilute in "lemonade," as prophylactic and as a curative agent. *Morphine*, 641, and *Morphine* and *Atropine*, 644, subcutaneously, relieves pain most quickly. *Iodides*, 261, and *Bromides*, 652, to cause excretion of lead. *Magnesia Sulphate*, 750, to overcome constipation.

COLIC, HEPATIC:

For the pain—*Morphine* and *Atropine*, 644, subcutaneously. *Spirit of Chloroform*, 596, *Ether*, 593, internally and by inhalation. *Nitro-glycerin* and *Amyl Nitrite*, 705, 709. *Tobacco*, 694, for pain by relaxing spasm. For the calculi—*Aliment*, *Sodium Phosphate*, 140. *Remedy of Durande*, 778. *Alkaline Mineral Waters*, 229. (See CALCULI, BILIARY.)

CONDYLOMATA:

Calomel, 293, also *Iodol*, 274, dusted over. *Iodoform*, 271, powder applied freely. *Carbolic Acid*, 382, a mild escharotic for simple cases. *Chromic Acid*, 815, in paste to destroy; solution of bichromate of potassa a useful lotion. *Nitric Acid*, 119, a dilute solution as a wash.

CONJUNCTIVITIS:

Calomel, 294, dusted over membrane. *Yellow Mercuric Oxide*, 294, an ointment of, with vaseline, a most efficient remedy for granular lids. *Tannin*, 346, and *Tannigen*, 349, in powder dusted over membrane, an excellent application. *Bismuth*, 164, also applied in powder directly. *Copper Sulphate*, 309, a smooth crystal applied directly, an approved remedy. *Silver Nitrate*, 303, a long-standing, useful agent. *Zinc Sulphate*, 320, a weak solution in rose-water, one of the best remedies for simple conjunctivitis. *Cadmium*, 326, in solution, a substitute for copper and zinc. *Fluid Extract of Ergot*, 501, applied undiluted, is said to be very efficient. For granular lids, *Jequirety*, 811, which sets up substitutive inflammation.

CONSTIPATION:

Aliment, 66, highly important in habitual: bread of unbolted flour, corn-meal bread, fruits, and succulent vegetables. *Cathartics*, 744. Physiological laxatives: *Arsenic*, 172, small doses of Fowler's solution increase action. *Nux Vomica*, 482, *Physostigma*, 688, *Belladonna*, 526, *Tabaci Vinum*, 694, a few drops at bed-time, *Muscarine*, 729, all act by either increasing secretion or muscular action, or both. *Faradization*, 466, of intestines. *Saline Mineral Waters*, 229, 233, and the purgative *Sulphurous Waters*, 253. *Enemata*, 769.

CONVALESCENCE:

Koumiss, 43, *Galazyme* and *Kefyr*, 44, valuable reconstituent stimulants. *Bitters*, 181, the simple, especially calumba and gentian. *Eucalyptus*, 186, a tonic of special utility after malarial diseases. *Hydrastis*, 190, tonic, and useful substitute for quinine. *Coca*, 560, a tonic and stimulant of the nervous system; also *Guarana*, 566, belonging to the same class. *Iron*, 148, especially sirup of the iodide, the carbonate, sulphate, and tincture of the chloride. *Phosphates*, 139, and *Phosphites*, 140, *Cod-liver Oil*, 126, *Pepsin*, 107, and *Pancreatin*, 109. *Wine*, 582.

CONVULSIONS:

Anæsthetics, 605, in uræmic and puerperal convulsions. *Bromides*, 612, in epileptic and epileptiform. *Chloral*, 617, in puerperal, uræmic, and epileptiform. *Morphine*, 640, hypodermatically, in full doses, in uræmic convulsions. *Veratrum Viride*, 620, in puerperal. *Cold Bath*, 87, especially in convulsions of infancy.

COUGH:

Asafœtida, 551, in cough by habit, bronchorrhœa and chronic bronchitis; also, under the same conditions, ammoniac, cubeb, copaiba, turpentine, etc. *Bromoform*, 660, for spasmodic cough and whooping-cough. *Chloral*, 617, in spasmodic cough, cough by habit, whooping-cough, etc. *Gelsemium*, 674, useful to quiet a nervous element in cough. *Lobelia*, 698, a nauseating expectorant of great utility in dry cough, bronchitis, asthma, etc. *Terebene*, 781, *Paraldehyde*, 585, *Pyridine*, 417, *Erigeron Oil*, 185, antispasmodic and stimulant expectorants. *Cerium*, 338, in cough associated with, or reflex from, stomach derangement. *Opium*, 642, in some form, of chief utility as a means of quieting cough. *Prunus Virginiana*, 183, anodyne and tonic expectorant. *Hydrocyanic Acid*, 701, indicated in cough of irritation, habit, reflex, and stomachal. *Grindelia*, 723, especially useful in spasmodic cough, and as a stimulant expectorant in chronic bronchitis. *Lactucarium*, 647, sirup, an excellent vehicle for cough mixtures. *Ipecacuanha*, 740, especially the fluid extract, an excellent nauseating expectorant.

CROUP. (See LARYNGISMUS STRIDULUS.)

Alum, 326, not depressing. *Mercury subsulphate*, 293, the most efficient emetic in croup. *Calomel*, 288, by some supposed to be sedative and aplastic, allaying laryngeal spasm and preventing formation of membrane. *Copper Sulphate*, 308, *Zinc Sulphate*, 318, as emetics inferior to turpeth mineral. *Tartar Emetic*, 324, causes dangerous depression in young children. *Apomorphine*, 736, effective but may be dangerous. *Quinine*, 201, in large doses highly useful. *Lactic Acid*, 110, and *Papain*, 108, solvents of false membrane, applied in spray or directly. *Carbolic Acid*, 379, in spray. *Lime-Water*, 223, and steam from slaking lime. *Ipecac*, 740, as an emetic. *Ethyl Iodide Vapor*, 362, *Pyridine*, 417, *Eucalyptol*, 187, and *Turpentine Vaporized*, 781.

CYSTS:

Iodine, 264, tincture or compound tincture of, injected, is effective. *Silver Nitrate*, 305, a solution injected into cysts to excite adhesive inflammation. *Galvano-Puncture*, 471, will usually permanently occlude.

CYSTS, HYDATID, of Liver, or elsewhere:

Iodine Injections, 263. *Galvano-puncture*, 471. Simple *Acupuncture*, 809, and escape of some fluid, often suffices.

DELIRIUM TREMENS:

Alcohol, 576, of great utility when assimilation can not proceed without it. *Bromides*, 652, may cure the preliminary "horrors," and succeed in mild cases of delirium tremens. *Chloral*, 617, very effective, but dangerous in old topers and cases of weak heart. *Paraldehyde*, 585, *Hypnone*, 590, *Urethan*, 588, are safer and probably not less efficient. *Pilocarpine*, 683, has proved highly useful. *Chloroform*, 597, by the stomach, lessens delirium and procures sleep. *Arnica Tincture*, 676, highly serviceable when there is much depression. *Digitalis*, 512, tincture or infusion, especially the former, in full doses in cases with cardiac depression, anæmia of brain, due to low tension and lessened vis-a-tergo. *Opium*, 640, must be given cautiously, and the attempt to overwhelm the brain avoided. *Quinine*, 207, to restore digestion and support the powers of life. *Cannabis Indica*, 556, sometimes is remarkably quieting. *Ammonium Carbonate*, 239, required in condition of depression. *Capsicum*, 788, has hypnotic effects of great value in mild cases.

DEMENTIA PARALYTICA:

Paraldehyde, 585, as a calmative. *Physostigma*, 690, has seemed to retard the progress. *Gold and Sodium Chloride*, 297.

DIABETES:

Aliment, 56, 67, all saccharine and starchy food excluded. *Buttermilk*, 60. The *Milk-Cure*, 67, has succeeded remarkably in some cases; *Buttermilk*, 60, may be better. *Alkalies*, 218, and *Alkaline Mineral Waters*, 229, of great value in the glycosuria of obese subjects. *Arsenic*, 175, and Clemens's solution and *Opium*, combined with advantage in thin subjects. *Sodium Arseniate*, 175, with phosphate of soda and the *Phosphates*, 140, which are also useful of themselves. *Lactic Acid*, 111, has sometimes done good. *Oxygen*, 367, *Hydrogen Dioxide*, 368, *Salicylic Acid*, 399, *Opium*, 642, especially codeine, restrains the waste of sugar. *Gold and Sodium Chloride*, 297, is a promising remedy. *Saccharin*, 418, as a sweetener of foods, and as an antiseptic. *Intravenous Injection of Ammonia*, 26, in diabetic coma.

DIABETES INSIPIDUS:

Dry Diet, 55, *Ergot*, 501, is one of the most efficient remedies. *Pilocarpus*, 684, has done good in some cases. *Valerian*, 554, restrains the flow but does not cure. *Muscarine*, 730, has been used with apparent success. *Auri et Sodii Chloridum*, 298, has been of benefit when sclerosis is developing. *Potassium Iodide*, 260, has cured cases of syphilitic origin.

DIARRHŒA:

Chalk, 223, in the diarrhœa of children, *mistura cretæ*, with or without opium. *Calomel*, 287, in minute doses, or hydrarg. cum creta, when the stools are pasty and whitish. *Bismuth*, 163, especially combined with creosote and glycerin, is useful, but large doses are necessary; also *Dermatol*, 165. *Zinc Salts*, 318, especially the *Oxide*, which may be given with bismuth, or the sulphate with morphine in the diarrhœa of adults. *Copper Sulphate*, 308, is the most efficient of the mineral astringents in chronic diarrhœa; is usually combined with opium. *Arsenic*, 172, Fowler's solution, with tincture of opium when undigested food is passed soon after meal, and in chronic diarrhœa. *Mineral Acids*, 116, especially sulphuric, in profuse watery stools, or Hope's mixture. *Lead Acetate*, 314, one of the most generally useful as tringents. *Camphor*, 546, with or without opium, for summer diarrhœa. *Camphoric Acid*, 549, especially in tuberculous diarrhœa. Ergot, 499, has proved very successful in some epidemics. The newer remedies, also highly efficient, are *Salol*, 409, and *Naphtalin*, 416, supposed to be decomposed by pancreatic solution, and therefore act locally by the released constituents. *Tannic Acid*, 343, and vegetable astringents containing it, especially rubus, kino, catechu, are much employed in simple diarrhœa. *Aliment*, 53, 55, 56, 59, and 66, milk-cure, raw-meat pulp, but caution is necessary in respect to the latter, because of danger of tænia.

DIPHTHERIA:

Belladonna, 527, useful at outset to check exudation, and later to support weak heart. *Carbolic Acid*, 379, locally in solution and spray, and systemically, and *Sulphocarbolates*, 385. *Chlorine*, 370, aqua chlori and chlorinated lime and soda topically to correct fetor and destroy germs. *Hydrogen Dioxide*, 368, and *Pictet Liquid*, 373. *Lactic Acid*, 110, one of the best solvents. *Sulphurous Acid*, 247, an antiseptic, in spray of dilute solution to fauces. *Quinine* by local application to nares and fauces, 207. *Potassa Chlorate*, 216, 218, more largely used than any remedy, topically, and by the stomach. *Iron*, 149, tincture of the chloride much employed, undiluted to the fauces, and by the stomach in full doses; also largely prescribed with potassa chlorate. *Acid Muriatic*, 117, was formerly applied to exudation. *Acid Salicylic*, 396, and the salicylates, the former also locally, to reduce temperature and prevent systemic infection. *Resorcin*, 404, acts similarly to carbolic and salicylic acids. *Alcohol*, 576, very much prescribed for support, and to prevent diffusion of the poison. *Pilocarpus*, 685, supposed to act locally in detaching false membrane. *Eucalyptus*, 186, *Turpentine*, 780, and *Terebene*, 782, in vapor. *Salol*, 409, *Naphtol*, 414, and other antiseptics are now used with varying success; but especially the *Antitoxins*, 438.

DROPSY:

Digitalis, 510, one of the foremost remedies, especially in cardiac and renal dropsy, less so in dropsy of cavities. The "digitalis group" contains some of the most effective remedies, as *Squill*, 793, *Caffeine*, 566, *Strophantus*, 518, *Adonidin*, 520, and others. They have effects similar to digitalis, and are prescribed under the same conditions. *Juniper*, 789, *Scoparius*, 791, and its alkaloid, *Sparteine*, 519, and other urino-genitals having diuretic properties, of great value in cardiac dropsy; must be used cautiously in renal dropsy. *Copaiba*, 784, especially the resin, has given good results in ascites. *Potassa Salts*, 218, especially bitartrate and acetate largely diluted, highly useful in renal dropsy. *Iron*, 151, especially tincture of the chloride, alone or in Basham's mixture, as a diuretic and to correct anæmia. *Pilocarpus*, 683, very valuable in renal dropsy when secretion of urine is much reduced or suppressed, and when convulsions occur. *Hydragogue Cathartics*, 767, especially indicated in ascites. *Saline Purgatives*, 750, in general dropsy. *Dry Diet*, 54, *Milk-Cure*, 59, *Whey*, 59, and *Koumiss Cures*, 59.

DYSENTERY, ACUTE:

Aliment, 66, of first consequence. *Saline Purgatives*, 751, especially Epsom salts in acute dysentery, with bloody discharges and high fever. *Ipecacuanha*, 741, a remedy of highest value in acute, epidemic, and puerperal; must be administered in large doses; milk a good vehicle. *Silver Nitrate*, 302, *Copper Sulphate*, 307, *Zinc Sulphate*, 318, are excellent astringents after the more acute symptoms. *Lead Acetate*, 314, may be used at any period, but better after action of salines, in acute disease. *Opium*, 630, combined with some of the astringents, but given after the action of salines in the acute disease. *Turpentine*, 778, in epidemic dysentery of low type. *Ergot*, 499, has been used with success in acute. One of the new antiseptics, *Naphtalin*, 416, has proved a valuable remedy in diarrhœa, and it also entirely deodorizes the stools. *Salol*, 409, is highly efficient in arresting intestinal fermentation.

DYSENTERY, CHRONIC:

Aliment, 56, 60. *Grape-Cure*, 55, *Arsenic*, 172—Fowler's solution with opium. *Iron*, 147, pernitrate, a powerful astringent. *Tannic Acid*, 343, with milk-diet, and the vegetable astringents. Silver, copper, and zinc salts (as above), with opium. *Nux Vomica*, 482. *Ergot*, 499, *Ipecac*, 741, and especially the antiseptics *Naphtalin*, 416, and *Salol*, 409.

DYSMENORRHŒA:

Aconite, 715, and *Pulsatilla*, 722, for the congestive form especially succeeding to suppression. *Ergot*, 499, under the same conditions as the two preceding; also *Cimicifuga*, 522, and *Potass. Permanganat.*, 158, *Camphor*, 547, *Gelsemium*, 675, and *Apiol*, 794, are useful in the neuralgic form. *Amyl Nitrite*, 706, and *Spirit. Glonoin*, 709, afford relief quickly. *Chloroform*, 596, *Chloral*, 618. *Cannabis Indica*, 557, *Morphine*, 641, especially with *Atropine*, 645, all give relief in painful menstruation. When menorrhagia coexists, or there is plethora, *Sodium Bromide*, 657. *Electricity*, 469; galvanism during the interval is highly useful. *Iron*, 151, in anæmic cases. *Viburnum*, 365. *Antipyrin*, 413, *Methylal*, 586, *Urethan*, 588, and other members of the antiseptic group.

314, and the other mineral astringents, with opium, are curative.

EPILEPSY:

Amyl Nitrite, 706, inhaled when aura is felt may prevent seizure; *Nitro-glycerin*, 710, also, if there be more time. *Potassium Bromide*, 654, is the most useful remedy, but is adapted to the cases occurring in the daytime, to the *grand mal*, and to reflex epilepsy, and to the condition of cerebral hyperæmia rather than anæmia. *Chloral*, 618, is the most suitable remedy for the nocturnal variety. *Cannabis Indica* and *Cannabinum Tannicum*, 556, *Atropine*, 529, *Strychnine*, 484, *Picrotoxin*, 491, are suitable for *petit mal*, for nocturnal variety, for cases characterized by anæmia and depression, and must be faithfully persisted in for a long time. The last-named seems most promising. *Silver Nitrate*, 302, formerly much prescribed, and not without utility, but the danger of staining is great. *Salts of Copper*, 309, especially *Cuprum Ammoniatum*, *Zinc Oxide*, 319, so-called nervine tonics, have been beneficial, but are not curative. *Iron*, 150, especially the bromide, with potassium bromide to prevent the anæmia and depression caused by the latter. *Iodides*, 260, when syphilitic in origin.

EPISTAXIS:

Ergot, 503, *Barium Chloride*, 242, *Digitalis*, 509, *Ipecacuanha*, 742, restrain hæmorrhage by acting on the vessels. *Turpentine*, 779, in oozing from relaxation. Locally *Tannin*, 345, in solution injected. *Iron*, 146, subsulphate in spray, or weak solution applied by irrigation; also *Iodic Acid*, 266. *Alum*, 337, powder insufflated, or solution injected. *Transfusion*, 29, when a fatal result is threatened from loss of blood. Intravenous injection of *Ammonia* when heart fails, 237. Subcutaneous injection of *Ether*, 594.

EPITHELIOMA:

Coptis, 181, infusion or decoction locally, especially in epithelioma of the tongue. *Arsenic*, 176, persistently used. *Potassium Chlorate*, 225, said to be very effectual applied in powder. *Zinc Chloride*, and *Sulphate* dried, 320, useful escharotics. *Carbolic Acid*, 382, injected beneath tumor. *Salicylic Acid*, 400, and *Boric Acid*, 420, *Pyoktanin*, 414, and *Bromine*, 372, applied topically. *Teucrin*, 432, injected.

ERYSIPELAS:

Aconite, 714, in the idiopathic variety, when there is much fever. *Belladonna*, 531, a very beneficial remedy, combined with aconite when there is sthenic reaction. *Quinine*, 208, in full doses in the more severe cases, to sustain the powers of life and prevent cerebral embolism. *Salicylic Acid* and *Salicylates*, 396, *Sodium Benzoate*, 423, *Resorcin*, 404, and *Salol*, 409, to prevent systemic infection in traumatic variety. *Ammonium Carbonate*, 239, when cardiac depression exists. *Iron*, 149, especially tincture of the chloride in large doses. Locally, *Argenti Nitras*, 304, according to Higginbotham's method, *Carbolic Acid*, 382, *Trichlorphenol*, 386, and the antiseptics generally to the inflamed area. Oil inunctions are very grateful in simple erysipelas, 124. *Antitoxins*, 438.

ERYTHEMA:

Quinine, 208, is very effective in erythema nodosum; *Belladonna* in the simple form, 531, *Zinc*, 320, *Alum*, 327, and *Lead*, 315, are suitable local applications, as lotions. *Bismuth* dusted over the surface allays irritation, 164. When the disease is reflex from gastro-intestinal disorder, *Nitric* and *Muriatic Acids*, 119, are beneficial.

EXOPHTHALMIC GOITRE:

Iron, 152, and *Chalybeate Waters*, 159, for the anæmia. *Digitalis*, 513, *Barium*, 242, *Ergot*, 501, and in some cases *Sparteine*, 519, raise the arterial tension and slow the heart. *Galvanism*, 469, in uncomplicated cases, is decidedly curative.

FAVUS:

Cod-liver Oil, 126, locally, and in case of debility, by the stomach. *Carbolic Acid*, 382, an efficient parasiticide. *Naphtol*, 416, still more useful. *Myrtol*, 430, *Resorcin*, 404, *Salicylic Acid*, 400, and *Boric Acid*, 420, are efficient local applications.

FEET, FETOR OF:

Potassa Permanganate, 159, in solution, will remove fetor temporarily. *Sodium Bicarbonate*, 224, a saturated solution, is serviceable. *Salicylic Acid*, 399, in powder freely dusted over the feet and stockings, is very effective. *Benzoin Tincture*, 422, when "frost-bite" is the cause, but useful in all.

FELON:

Silver Nitrate, 305, a strong solution in nitric ether applied over the part may abort the affection, if at the beginning. *Lead Nitrate*, 315.

FEVER:

Aconite, 714, highly useful in simple inflammation, and in the eruptive fevers. *Aliment*, 63, must be regulated. *Alcohol*, 538, does good when the temperature declines, the pulse falls, the skin perspires, and the tongue grows moist. *Baths, Cold*, 83, certain method of reducing body-heat, and especially valuable in typhoid and pneumonia. *Digitalis*, 510, is indicated in inflammatory fever and in the eruptive fevers during the first stage, and as an aid to quinine when employed as an antipyretic. *Quinine*, 204, occupies the first position as an antipyretic, and is more generally applicable than any other. *Chloral*, 616, reduces fever, and is highly useful when high febrile excitement coincides with delirium and wakefulness. *Salicylic Acid*, 396, *Resorcin*, 404, *Sodium Benzoate*, 422, are antipyretic and antiseptic. Among the newer contributions to the antipyretics, and most effective, are *Antipyrin*, 411, *Acetanilid*, 426, *Salol*, 409, *Calomel*, 289, and compound solution of *Iodine*, 261, the former administered during the first week, and the latter during the whole course of typhoid fever, affect the course and duration favorably; "the specific treatment" of the Germans. *Carbolic Acid*, 381, and *Carbolate of Iodine*, 380, have good effects in typhoid. *Turpentine*, 779, in typhoid, puerperal, and yellow fever, when there is much vaso-motor depression, hæmorrhage, etc.

Fissure of the Anus:
Hydrastis, 191, the fluid extract applied undiluted. *Iodoform*, 263, dusted well over the fissure, and *Iodo-tannin*, 264, applied in the same way. *Trichlorphenol*, 386. *Carbolic Acid*, 382. *Cocaine*, to allay irritability, 561.

Fissure of Nipples:
Iron, 153, liquor ferri subsulph., and glycerin applied with a brush. *Tannin*, 346, in powder or the glycerite. *Tincture of Benzoin*, 422, with glycerin. *Brandy*, 577, with or without glycerin. *Collodion*, 819, flexile collodion, or *Liq. Guttæ Perchæ*, 819, applied to close fissure. *Lead Nitrate*, 315, with simple ointment or glycerin, is the most efficient application.

Flatulence:
Calumba, 181, with aromatics. *Camphor*, 511, will often give prompt relief. *Chloroform*, 596, especially the spirit. *Asafœtida*, 551, *Valerian*, 554, and *Spirit of Ether Compound*, 593, are adapted to nervous and hypochondriacal cases. *Turpentine*, 736, is indicated in the flatulence of fevers, peritonitis, etc. *Nux Vomica*, 482, *Belladonna*, 526, *Physostigma*, 689, and probably *Muscarine*, 729, give relief to those cases of flatulence dependent on paresis of the muscular layer of the bowel; also the formula of Wood, 181. Diet is of the highest importance, in cases arising from intestinal indigestion.

Freckles:
Alkalies, 224, in form of a lotion composed of potassa carbonate and chloride of soda. *Sodium Biborate*, 420, a saturated solution, is a safe and often successful lotion. *Naphtol*, 416, *Boric Acid*, 420, and *Tincture of Benzoin*, 422, are newer and efficient remedies.

Gall-Stones. (See Calculi, Biliary.)

Gangrene:
Bromine, 372, one of the best escharotics in hospital gangrene to arrest morbid action. *Chlorine*, 371. *Chromic Acid*, 815, is a highly efficient caustic, and penetrates deeply with little pain, comparatively. *Zinc Chloride* and dried *Sulphate*, 320, powerful, but painful. *Potassa Fusa*, 225, an active escharotic. *Nitric Acid*, 119,
next to bromine, is the most useful
tic to arrest the destruction of part
ternal, by gangrene. The *Antiseptic*
plied to the affected surface, incl
Carbolic Acid, 382, *Salicylic Acid*, 40
sorcin, 404, *Salol*, 409, *Iodoform*, 271,
tol and *Thymol*, 430, and others ar
most effective now used. To these
phor, 548, may be added. *Turpentin*
used locally, and *Eucalyptol*, 186, are
ly useful in gangrene of the lungs to
vent extension and to destroy fetor.

Gastralgia:
Aquapuncture, 809, injections under the
of water over the epigastrium, af
much relief. *Alum*, 336, is useful i
cases with acidity and pyrosis. *Ar*
171, one or two drops t. d. of Fowler's
tion, is the most generally effective
remedies. *Ether*, 593, *Chloroform*,
Atropine, 526, and the anodynes, alla
pain. *Bismuth*, 163, and with *Creosot*
Glycerin, 379. *Silver*, 301, *Zinc Oxide*,
and *Manganese Oxides*, 156, make a
manent impression on the nerve-endin
the mucous membrane, and hence
permanent results. *Hydrocyanic*
701, and *Cyanide Potass.*, 703, if suc
ful, are speedily so. *Nitro-glycerin*,
also acts quickly and often effectively.
cases having a distinct periodicity,
nine, 200, and *Salicylic Acid*, 395,
acted well, and *Resorcin*, 404, will p
bly be found beneficial. *Nux Vomica*,
may remove the morbid state on whic
pain depends. *Morphine*, 635, subcu
ously, alone or combined with atro
stops the pain at once. *Galvanism*,
the pneumogastric and sympathetic a
on, has been successful. *Diet*, 62, is o
utmost consequence.

Gastric Catarrh:
Aliment, 65, especially the milk-cure.
Arsenic, 171, is the most important r
dy; next are *Oxides of Silver*, 301,
ganese, 156, and *Zinc*, 318, *Bismuth*,
Alum, 335, and *Lead Acetate*, 313.
Bitters, 180, especially *Calumba*, 180,
Vomica Tincture, 482, *Cinchona Infu*
Eucalyptus, 186, and *Hydrastis*, 190,
beneficial, if not continued too long;
Wild Cherry, 183. To these may be a
the various *Antiseptics*, as *Creosote*.
et seq., and others of the same group.

Gastric Ulcer:
Milk-Cure, 59, 65, *Rectal Alimentation*
Nutrient Enemata, 71, *Lead Acetate*,
sedative, and arrests hæmorrhage.
muth, 163, allays pain and arrests v
ing. *Arsenic*, 171; Fowler's solutio
drop-doses also lessens pain and vom
remarkably. *Silver Oxide* and *Nit*
301, promote cicatrization and relieve
Morphine and *Atropine*, 635, 645, a
pain and vomiting, even in very m
quantity.

GASTRITIS, ACUTE:
Ice, 82, *Hydrocyanic Acid*, 701, *Morphine*, 635, subcutaneously or endermically. *Creosote*, 379. *Rectal Alimentation*, 71. *Papäin*, 108, in the apepsia of infants.

GASTRITIS, CHRONIC. (The same as for GASTRIC CATARRH.)

GLANDS, LYMPHATIC, AFFECTIONS OF.
Carbolic Acid, 382, properly diluted, injected into the substance of the glands; also *Iodine*, 259, and *Iodoform*, 272, solutions. *Iron* and *Manganese Iodides*, 148, 156, internally, and tincture of iodine injected into the substance of glands, 262. *Sulphides*, 249, are said to mature or abort suppuration in glands. *Calcium Chloride*, 223, and *Phosphates*, 140, are highly useful in strumous inflammation and suppuration. *Pilocarpus*, 682, 684, has a curative action in acute affections of parotid and submaxillary glands. *Conium*, 664, locally and systemically, has long been regarded as discutient. *Mercury*, 293, especially bichloride, in acute inflammatory diseases of tonsils, parotid and submaxillary glands. *Lead Iodide*, 262, and *Iodoform*, 263, 268, as an ointment externally. *Ointment of the Red Mercuric Iodide*, 294, has remarkable effects in goitre, enlarged spleen, etc.

GLEET:
Iron, 153, tinct. ferri chloridi, in anæmic subjects. *Turpentine*, 781, is beneficial when the local condition is one of relaxation. *Juniper*, 789, *Cantharides Tinct.*, 799, are useful under the same circumstances. *Iodoform*, 263, and *Iodol*, 274, in pencils. *Corrosive Chloride*, 295, in solution. *Pyoktanin*, 412, *Creolin*, 407, *Teucrin*, 431, and other remedies of the group. *Blisters*, 807, to the perinæum are very beneficial.

GOITRE:
Iodine, 259, both internally and locally, effective in the case of simple hypertrophy. *Ointment of the Red Mercuric Iodide*, 294, exceptionally useful in same state. Injections of *Tincture of Iodine*, 259, 262, 263, very effective in cystic degeneration. *Electrolysis*, 471, has succeeded in simple hypertrophy and cystic state of gland. *Animal Extracts*, 432.

GONORRHŒA:
Internal Remedies.—*Copaiba*, 784, *Cubeb*, 786, *Buchu*, 790, and other urino-genital remedies, more useful after acute symptoms. *Colchicum*, 354, *Saline Laxatives*, 750, *Aconite*, 715, and *Veratrum Viride*, 720, during the first acute symptoms, *Turpentine*, 781, and *Cantharides Tincture*, 799, for the chronic stage.
Injections.—*Bismuth*, 164, with or without *Fl. Ex. of Hydrastis*, 191, is one of the best. *Methylene Blue*, 414, *Creolin*, 407, and *Naphtol*, 416, have proved very efficient topical applications. *Zinc Sulphate*, 320, a very weak solution, often repeated, can be used alone, or chloride or sulphate of zinc, and *Lead Acetate*, 315, in combination. After the acute symptoms, stronger solutions and pencils of above and *Silver Nitrate*, 305, *Copper Sulphate*, 309, *Iron Subsulphate*, 153, *Cadmium Sulphate*, 326, *Alum*, 336, and *Tannin*, 345.

GOUT:
Aliment, 59, 67, of first importance. *Alkalies*, 224, and *Alkaline Mineral Waters*, 229, especially potash and lithium salts. *Manganese Salts*, 156, very serviceable in chronic gouty affections. *Salicylic Acid*, the salicylates, and *Salol*, 409, very effective in the acute form. *Guaiac*, 357, after acute symptoms. *Colchicum*, 353, especially colchicine, the most celebrated remedy for the paroxysms. *Arnica*, 636, and *Trimethylamine*, 637. *Sulphurous Waters*, 253, *Sulphur-Baths*, 250.

GUMS, AFFECTIONS OF:
Alum, 337, for spongy and bleeding. *Tannin*, 345; especially *Glycerite*, 345, for same condition. *Carbolic Acid*, 382, and *Iodoform*, 263, when fetor is present. *Benzoin Tincture*, 422, with or without glycerin. *Resorcin*, 404.

HÆMATEMESIS:
Alum, 337, especially in passive. *Lead Acetate*, 314, may be used in all conditions. *Iron*, 146, as Monsel's solution, one of the most effective applications. *Iodic Acid*, 266, a safe and effective hæmostatic. *Tannin*, 345, and the vegetable astringents, especially *Hamamelis*, 341, *Rhatany*, 341, and *Logwood*. 340, *Turpentine*, 781, in weak and relaxed state of vessels. *Ergotin*, 503, subcutaneously.

HÆMATURIA:
Ergot, 503, by the stomach or subcutaneously; may be combined with rhatany, ipecacuanha, or other astringents. *Gallic Acid*, 343, one of the most useful remedies. *Rhatany*, 341, owes its utility to the presence of tannic and gallic acids. *Quinine*, 207, is highly effective in the intermittent or malarial form; *Turpentine*, 781, in the hæmorrhagic diathesis, and in the passive form.

HÆMOPTYSIS:
Ergot, 503, with ipecac and a little opium by the stomach; ergotin subcutaneously. *Gallic Acid* and ergot, 343, by the stomach. *Ipecacuanha*, 742. *Digitalis*, 509. *Tinct. of Verat. Viride*, 719. *Barium Chloride*, 242. *Iron*, 146, subsulphate solution in spray, a highly effective application. *Lead Acetate*, 315, with opium, frequently prescribed, but not so effective as those previously named.

HÆMORRHAGE AND HÆMORRHAGIC DIATHESIS:
Arterial Sedatives.—*Digitalis*, 503. *Verat. Viride*, 719. *Aconite*, 719, *Lead Acetate*, 315, *Barium Chloride*, 242, *Venesection*, 813, *Ipecac*, 742, and *Ergot*, 503, act by slowing the heart and diminishing the

caliber of the vessels, and are therefore adapted to active hæmorrhage. *Turpentine*, 781, *Ammonia*, 238, by stomach and by intravenous injection, and *Alcohol*, 576, relieve, by increasing the contractile energy of the vessels, and are therefore indicated in passive hæmorrhage. To these must be added *Transfusion*, 29, when death is imminent from simple loss of blood. Astringents are employed locally and systemically, and include *Alum*, 337, *Lead Acetate*, 814, *Iron*, *Subsulphate* and *Chloride*, 151, 153, *Sulphuric Acid*, 118, *Tannin*, 343, *Gallic Acid*, 343, and the *Vegetable Astringents*, 341, 346.

HÆMORRHAGE, CEREBRAL:
Venesection or *Leeches*, 814, when the blood-pressure is high and hæmorrhage threatened or proceeding. *Purgatives*, 750, under the same circumstances. *Ergotin*, 503, *Barium Chloride*, 242, and arterial sedatives, when collateral hyperæmia comes on.

HÆMORRHAGE, INTESTINAL:
Tannic Acid, 345, and vegetable astringents. *Lead Acetate*, 814, *Sulphuric Acid*, dilute, 118. *Iodic Acid*, 265, an active hæmostatic. *Iron*, pernitrate, 141. *Turpentine*, 781. *Opium*, 637, to quiet intestinal movements. *Ice*, 88, to abdomen. *Ergotin*, 503, hypodermatically.

HÆMERRHAGE, UTERINE:
Ergot, 503, fluid extract in full doses. *Ipecac*, 742, carried to nausea merely, is highly effective. *Digitalis*, 503, *Barium Chloride*, 240, *Sulphuric Acid*, dilute, 118, small doses frequently, and *Epsom Salts*, 708. *Cold*, 88. *Hot Water*, 88. *Iron*, 152; Monsel's solution, diluted, injected.

HÆMORRHOIDS:
Aloes, 758, in recent hæmorrhoids, as after delivery, highly useful. *Ergot*, 499, in dilated hæmorrhoidal veins without new tissue, by the stomach and topically. *Alkaline*, 233, *Sulphurous*, 253, and purgative *Chalybeate Waters*, especially Bedford, 232. *Saline Purgatives*, 750, notably Epsom salts, in bleeding piles. *Senna*, 754, the confection especially, *Sulphur*, 745, and *Cream of Tartar*, 751, to render movements soft and easy; also *Cascara Sagrada*, 747, and *Pulv. Glycyrrhiz. Comp.*, 745. The *Grape-Cure*. 55. *Alum*, 336. *Iron*, 153; Monsel's solution to arrest bleeding. *Leeches*, 814, to inflamed piles. *Nitric Acid*, 119, to the mulberry, bleeding pile. *Iodic Acid*, 265, *Ung. Gallæ*, 347, ointment for hæmorrhoids. The *parenchymatous injection* of *Carbolic Acid*, 382, one of the best remedial measures.

HAY-FEVER:
Arsenic, 173, internally and in cigarettes. *Atropine*, 527, when secretion is profuse. *Carbolic Acid*, 379, by inhalation. *Bromine*, if cautiously used, highly efficient, 371. *Quinine*, 205, 207, is useful at onset in spray, locally, and later as a tonic. *Iodides*, 258, carried to iodism, afford a great relief; may be combined with arsenic. Also *Ethyl iodide*, 267, *Pyridine*, 417, and others, by inhalation. *Grindelia*, 723, for the asthmatic symptoms. *Muscarine*, 729, will probably prove useful in the asthmatic stage, if membrane is dry. *Morphine*, 644, is probably beneficial at any stage, but great danger of morphine-habit. *Pilocarpine*, 683. *Nitro-glycerin*, 709, for the asthma. *Cocaine*, 561, to the nose a highly efficient application, but liable to abuse.

HEADACHE:
Ammonia, 237, for nervous headache; especially aromatic spirits, and the *Carbonate*, 230, for migraine. *Arsenic*, 173, for cerebral congestion and hemicrania. *Bromides*, 616, for true migraine. *Digitaline*, 512, in congestive hemicrania, from venous hyperæmia. *Ergot*, 501, in the headache of miliary aneurisms and in arterial hyperæmia. *Galvanism*, 468, applications to cervical sympathetic during intervals, persistently, and mild transverse applications during seizure. *Amyl Nitrite*, 705, by inhalation in cases characterized by vasomotor spasm (pallor of face). Also *Nitro-glycerin*, 709, internally under same conditions. *Potassium Cyanide*, 703, a solution applied on compress to painful region. *Sodium Phosphate*, 140, in headache due to "biliousness." *Picrotoxin*, 491, in neuralgic headache; also *Strychnine*, 482.

HEART, DISEASES OF:
Aconite, 714, *Veratrum Viride*, 719, and *Bromides*, 651, for overaction and simple hypertrophy. *Digitalis*, 509, in rapid action with low tension and valvular lesions. Also *Convallaria*, 516, *Sparteine*, 519, *Strophanthin*, 518, and *Adonidin*, 520. *Cimicifuga*, 522, under the same conditions. *Ergot*, 499, is useful in dilated heart. *Amyl Nitrite*, 705, in angina pectoris; also *Nitro-glycerin*, 709. *Iron*, 151, remarkably beneficial in the irritable heart of anæmia. *Morphine*, 637, hypodermatically in dilated heart and general dropsy therefrom. *Quinine*, 201, in peri- and endocarditis and cardiac weakness. *Ammonia*, 238, inhaled, intravenous, and by the stomach in sudden failure. *Atropine*, 527, a prompt cardiac excitant.

HEMIPLEGIA:
Galvanism, 465, cautiously applied to the brain; faradism to the muscles, if they waste or degenerate. *Strychnine*, 483, 486, hypodermatically into the paralyzed muscles, after local troubles have ceased. *Massage*, 102.

HEPATIC DISEASES:
Aconite, 672, in acute inflammation. *Alkaline Mineral Waters*, 229; also *Sulphurous*, 253, in portal congestion. *Colchicum*, 353, is an active remedy in congestion of the liver. *Nitro-Muriatic Acid*, 115, and the acid bath, are useful in torpor of liver.

The resin-bearing purgatives, *Rhubarb*, 755, and the following: *Aloes*, 757, *Podophyllum*, 762, *Euonymin*, 764, and especially *Ipecacuanha*, 740, the most effective. *Ammonium Chloride*, 237, and *Iodides*, 259, including *Iodoform*, 272, are useful in catarrh of bile-ducts. *Salol*, 409, and *Salicylic Acid*, 397, have decided effects. *Sodium Phosphate*, 140, one of the most certain and useful cholagogues. *Gold and Sodium Chloride*, 297, is effective in sclerosis. *Mercurials*, 287, have questionable utility. *Phosphorus*, 135, prevents the formation or checks the growth of connective tissue (sclerosis).

HERPES:

Copper Acetate, 309, as an ointment; *Calomel*, 294, also as an ointment, and *Zinc Ointment*, 320, are curative. *Belladonna* or *Atropine*, 533, internally, is useful. The following antiseptics: *Aristol*, 277, *Alumnol*, 338, *Boral*, 338, *Nosophen*, 276, *Ichthyol*, 350, *Pyrogallol*, 348, *Thymol*, 429, *Boric Acid*, 420, *Aristol*, 277, *Naphtalin*, 416, *Resorcin*, 404, *Salicylic Acid*, 400, *Trichlorphenol*, 386, *Carbolic Acid*, 382. *Galvanism*, 470, in cases having a neurotic origin, as H. zoster.

HOARSENESS:

Nitric Acid, 118, is highly effective in hoarseness of singers and reflex from stomach troubles. *Atropine*, 533, affords prompt relief usually in hysterical aphonia.

HYDROCELE:

Carbolic Acid, 382, injected into the sac after the withdrawal of the fluid. *Iodine Tincture*, 264, injected in the same way. *Silver Nitrate*, 305, a sufficiently strong solution thrown into the sac after fluid is removed. *Galvano-puncture*, 471, sometimes succeeds admirably.

HYDROPHOBIA:

Amyl Nitrite, 705, by inhalation, and *Nitroglycerin*, 706, by the stomach, should be faithfully tried. *Curara*, 671, has apparently succeeded. *Morphine*, 601, *Paraldehyde*, 585, *Methyl Chloride*, 586, *Hypnone*, 590, *Ethyl Bromide*, 592, are palliative, and may have curative effects. *Methylal*, 586, *Hypnol*, 590, and *Urethan*, 588, and its congeners, promise utility.

HYDROTHORAX:

Iodine Injections, 264, to prevent reaccumulation of fluid. *Pilocarpus*, 683, to cause absorption. *Resin of Copaiba*, 784, as a diuretic. *Dry Diet*, 54.

HYPERPYREXIA:

Cold Bath, 84, *Quinine*, 201, in massive doses, and the *Antipyretics* of the antiseptic group.

HYPOCHONDRIA:

Arsenic, 173, has good effects in the hypochondria of the aged. *Colchicum*, 353, with colocynth, to deplete the portal circulation. *Caffeine*, 566, is a serviceable cerebral stimulant in these cases. *Asafœtida*, 551, is particularly indicated and has great value in cases characterized by much flatulence. *Opium*, 639; in some cases small doses of the tincture is a remedy of the first importance. *Cocaine*, 562, but danger of cocaine habit; *Cannabis*, 556. *Chloral*, 617, may be required to procure sleep. *Gold and Sodium Chloride*, 298, gives excellent results in the hypochondria of the aged.

HYSTERIA:

Ammonia, 239, the aromatic spirits, for the hysterical seizure. *Asafœtida*, 551, *Valerian*, 554, *Camphor*, 547, *Eucalyptus*, 186, *Ether*, 593, are useful remedies to relieve the vapors and accompanying symptoms. *Phosphates*, 139, *Iron*, 150, *Coca*, 562, *Cod-liver Oil*, 124, and the "rest-cure," are the remedies to relieve the abnormal mobility of the nervous system.

IMPETIGO:

Glycerite of Tannin, 345, an excellent application. *Lead Acetate*, 315, in solution. *Zinc Oxide*, 320, dusted over or ointment applied. *Quinine*, 208, usually improves. The *Mineral Acids*, 119, in intestinal indigestion.

IMPOTENCE:

Phosphorus, or *Zinc Phosphide*, 134, 138, are efficient stimulants. *Cannabis Indica*, 557, also stimulates the function. *Nux Vomica*, 483, *Sanguinaria*, 361, also increase sexual activity, but differ in degree. *Ergotin*, 504, subcutaneously about the dorsal vein of the penis, or *Fluid Extract of Ergot*, 501, by the stomach, increase the vigor of the erections. *Arsenic*, 175, in functional impotence, and *Iron Arseniate*, 175, act as a tonic to the organs. *Gold and Sodium Chloride*, 297, has also slowly acting aphrodisiac effects.

INCONTINENCE, NOCTURNAL:

Belladonna or *Atropine*, 530, carried to the point of inducing some physiological action. *Ergot*, 501, in cases due to paresis of the muscular layer of the bladder. *Iron*, 152, sirup of the iodide, in weak, anæmic subjects.

INDIGESTION:

Aliment, 56, 60. In stomach indigestion, give foods digested chiefly in intestine, and in intestinal indigestion, food digested chiefly in stomach. *Milk-Cure*, 59. *Pepsin*, *Pancreatin*, *Ingluvin*, and *Papäin*, 109, digestive ferments, 109, increase activity and thoroughness of digestion. *Mineral Acids*, 115, and *Lactic Acid*, 111, in atonic dyspepsia and indigestion. *Alkalies*, 217, and *Alkaline Mineral Waters*, 229, 233, for the indigestion of the obese, gouty, and rheumatic. *Sulphurous Acid*, 247, for indigestion with pasty vomiting, *sarcina*, etc. *Bismuth*, 164, and *Dermatol*, for painful indigestion and nausea; also *Hydrocyanic Acid*, 702. *Strychnine*, 482, or tinct. nucis vom., to stimulate organs; also *Ignatia*, 488, and *Picrotoxin*, 491. *Aloes*, 757, in indigestion with torpor of large intestine, and pasty motions. *Alcohol*, 575, an excellent stomachic tonic in moderate quantity for the indigestion of the old.

INFLAMMATION:

Aliment, 63. *Water*, 84, the methods of hydrotherapy, to reduce heat. *Alcohol*, 575, in condition of systemic and cardiac depression, as an antipyretic, etc. *Leeches*, 814, very useful in certain local inflammations superficially situated, the systemic condition being sthenic. *Aconite*, 715, useful in inflammation of respiratory organs and parenchymatous inflammations in general. *Veratrum Viride*, 719, *Gelsemium*, 512, *Arnica*, 677, and especially *Digitalis*, 675, are valuable as arterial sedatives to diminish blood-supply to inflamed area, and cease to be beneficial when exudations begin. *Belladonna*, 527, in some catarrhal inflammations is highly useful. *Alkalies*, 817, especially the potash salts and ammonia, are very valuable in the exudation stage. *Saline Cathartics*, 750, to lower the blood-pressure and to cause excretion of products of waste. To the remedies acting on the circulation may be added *Barium Chloride*, 242, and *Muscarine*, 720, and under some circumstances *Ergot*, 501. *Quinine*, 201, in full quantity, especially when combined with opium, may abort an incipient inflammation. *Opium*, 638, is the most important remedy in serous inflammation. *Tartar Emetic*, 824, affords undoubted good results in some forms, notably in acute bronchitis. *Pilocarpus*, 684, has very satisfactory results in exudation in the eye, pleura, etc.

INSOLATION. (SUNSTROKE.)

Cold Bath, 86, or douche or wet pack, for the state of high fever. *Morphine*, 640, hypodermatically. *Turpentine Enema*, 780, as a derivative. *Brandy*, 576, and *Ammonia*, 238, for heat-exhaustion, and the antipyretics, as *Salicylic Acid*, 396, *Acetanilid*, 426, *Exalgin*, 427, *Thymol*, 430, *Thymacetin*, 530, *Antipyrin*, 411, *Thallin*, 406, *Phenacetin*, 418, and other synthetical products of the same series in heat fever.

INSOMNIA:

Alcohol, 576, in the condition of cerebral anæmia, or in quantity to induce narcosis. *Paraldehyde*, 585, *Urethan*, 588, and its congeners, *Phenyl-Urethan* and *Chloral-Urethan*, are efficient hypnotics. *Hypnone*, 590, and *Hypnal*, 590, and *Methylal*, 586, act in a similar manner. *Chloral*, 616, the most direct and generally useful hypnotic. *Belladonna*, 532, in some morbid states with great restlessness and delirium; but *Hyoscyamine*, 538, *Hyoscine*, 540, and *Duboisine*, 542, in sufficient quantity, are more frequently successful, especially in the insomnia of mania, puerperal mania, etc. *Bromides*, 652, a direct hypnotic, but the action is easily prevented. *Morphine*, 640, *Morphine* and *Atropine*, 644, is generally the best sleep-producer in cases of pain, in some kinds of mania, and in melancholia. *Humulus*, 646, a hop-pillow, ha induced sleep; lupuline is more effective *Phosphorus*, 135, under some circumstance acts well. *Galvanization*, 465, of cervica sympathetic, causes sleep when circumstances are favorable. *Water*, 85, a tepid or warm bath at bed-hour, often succeeds *Massage*, 102.

INTERMITTENT FEVER:

Cinchona, 204. Quinine is prophylactic rightly used prevents malarial infection and in proper quantity arrests the paroxysms. In severe cases, combination with morphine is very effective. An attack impending may be arrested by *Amyl Nitrite*, 706, or *Nitro-glycerin*, 709, and *Pilocarpine*, 684, as respects the chill: *Chloroform*, 597, by inhalation, or by the stomach in a full dose, may prevent a chill. *Salicin*, 389, *Salicylic Acid*, 396, and *Resorcin*, 404, especially the last named, have decided antiperiodic qualities only inferior to quinine. *Carbolic Acid*, 381, hypodermatically, seems to be quite effective. *Apiol*, 794, also has very decided antiperiodic qualities. *Cinchonidine Salicylate*, 396, an antiperiodic of considerable value. Other substitutes for quinine are *Nitric Acid*, 118, which acts quite well in mild cases: *Hydrastine*, 190, has some antiperiodic power, but is an active tetanizer; *Eucalyptus*, 187, more adapted to chronic malarial poisoning, and for convalescence after attacks of fever; *Oleoresin of Capsicum*, 788, and *Nux Vomica*, 482, adjuncts to other and more powerful remedies. *Antipyrin*, 411, *Acetanilid*, 426, and *Salol*, 409, and the antipyretics of the antiseptic group.

INTERTRIGO:

Bismuth, 164, dusted over the surface. *Zinc Ointment*, 320. *Tannin*, in powder, 346. *Tannigen*, 349, *Alumnol*, 338, mild and unirritating applications.

INTESTINAL CATARRH:

Ammonium Chloride, 237. *Bismuth*, 164, is one of the best remedies. *Calomel*, 294, in minute doses frequently. *Silver Nitrate*, 302, *Copper Sulphate*, 308, *Lead Acetate*, 313, *Zinc Oxide* and *Sulphate*, 319, are excellent remedies, valuable in the order named. The vegetable tonic astringents, *Eucalyptus*, 186, *Hydrastis*, 190, and those containing *Tannic Acid*, 343, are also useful. *Salol*, 408, of special value because of the action of the pancreatic secretion and the more powerful germicides and antiseptics, 375 *et seq*, especially *Naphtalin* and *Ichthyol*.

INTESTINAL PARASITES:

Calomel, 288, for the round worm; also *Hydrocyanic Acid*, 701. *Carbolic Acid*, 382 but especially *Glycerin*, 821, for intestinal trichina. Remedies against the round worm, 771, *Santonin*, *Spigelia*, *The Bitters*, 181, especially *Quassia* against ascarides, etc. *Papäin*, 108, a solvent.

INTUSSUSCEPTION :

Effervescent Enemata, 770 : also *Irrigation*, 770, acting mechanically. *Tobacco Enema*, 694, to relax spasm. *Morphine*, 638, hypodermatically of first importance. *Belladonna*, 526.

IRITIS :

Atropine, 530, to prevent adhesions, and check inflammation by emptying vessels of iris. *Eserine*, 691, now much employed to break up adhesions and diminish intra-ocular tension ; also *Homatropine*, 534. *Pilocarpine*, 683, to cause absorption of exudations and effusions. *Mercury*, 288, of great importance, as most cases are specific. *Duboisine*, 542, is much employed as a substitute for atropine ; also *Scopolamine*, 544.

JAUNDICE :

Aliment, 55, 59, 63, especially the skim-milk cure, avoidance of fats, etc. *Alkalies*, 217, and the *Alkaline Mineral Waters*, 229, *Sodium Phosphate*, 140, the most useful remedy in catarrh of bile-ducts, and in incipient sclerosis. *Ammonium Chloride*, 237, and the *Iodide*, 257, and *Iodoform*, 271, are beneficial under the same circumstances. *Manganese*, 156, *Permanganate of Potassa*, 157, and *Arsenic*, 172, have unquestionable cholagogue effects, and stimulate the discharge of bile ; are adapted to the catarrhal form, and to the jaundice of gouty subjects. The resin-bearing cathartics, *Rhubarb*, *Aloes*, *Podophyllum*, *Iris*, and *Euonymin*, 752–765, promote the excretion of bile. *Nitro-Muriatic Acid*, 115, internally and by bath, has long had good repute in malarial jaundice. *Benzoic Acid*, 422, and *Benzoates*, 423, remove bile from system. *Salol*, *Pyridine*, and *Naphtalin* are useful in all cases of catarrhal jaundice. *Mercurials*, 287, are of doubtful utility, but good results seem to be obtained from small doses of calomel.

JOINTS, DISEASES OF :

Carbolic Acid, 382, in solution injected in synovitis, with reported good results. *Galvanism*, 470, highly useful in chronic affections. *Massage*, 102, produces remarkable results in stiffness and deformity of joints from inflammation and lack of use. *Oleate of Mercury and Morphine*, 294, is of great service in inflammatory affections of joints. *Silver Nitrate in Nitrous Ether*, 303, an efficient application to check inflammation. *Blisters*, 807, a succession of them about the joints, in cases of synovitis.

KERATITIS :

Atropine, 531, to check inflammation by causing contraction of the vessels. *Eserine*, 691, lowers intra-ocular tension and relieves pain. *Pilocarpine*, 683, is of great service in removing exudation and stopping inflammation. *Calomel*, 294, and *Yellow Oxide*, 295, in powder locally, very effective. *Zinc Sulphate*, 320, in solution, is an ordinary lotion in these cases, and is often prescribed with atropine. Lead lotions must be used with caution. *Cocaine*, 562, to relieve pain and check inflammation, alone or in combination with atropine.

LABOR :

Anæsthetics, 606 ; *Chloral*, 618, relieves pain and stops irregular action. *Ergot*, 502, is administered to hasten labor under suitable conditions, to cause expulsion of placenta, and to arrest hæmorrhage. *Morphine*, 645, hypodermatically, stops " false pains."

LACTATION :

Belladonna, 533, arrests the secretion of milk ; a solution of atropine may be applied to the gland. *Pilocarpus*, 684, increases secretion of milk. *Phosphates*, especially *Lime Phosphate*, 139, and the *Calcium Salts*, 223, are highly useful in the debility of lactation.

LARYNGISMUS STRIDULUS :

Quinine, 208, administered in the interval, may prevent attacks that recur frequently. *Nitro-glycerin*, 709, will speedily allay the spasm. An *Anæsthetic*, 605, will at once stop an attack ; a few drops of ether inhaled will usually suffice. *Bromides*, 656, will suspend attacks if a sufficient quantity is given, and prevent recurrences ; also *Bromoform*, 659. *Tartar Emetic*, 324, a nauseant, will stop the spasms, but may induce dangerous depression in young children. *Mercuric Subsulphate*, 734, is as effective, and safer. *Ipecac*, 740, will also arrest attacks. *Gold and Sodium Chloride*, 297, highly useful in respiratory neuroses.

LARYNX, DISEASES OF :

Aconite, 713, in acute catarrh, small dose of the tincture often administered. *Inhalations*, 8, of various astringent and anodyne substances ; also *Insufflation*, 7, of the same in powder ; *Tannin*, *Iodo-Tannin*, *Iodoform*, *Iodoform and Tannin*, 263 *et seq.*, *Nitrate of Silver*, *Copper and Zinc Salts*, *Nitrate of Bismuth*, *Monsel's Iron*, *Alum*, *Sulphurous Acid*, 247, *Bromine*, *Iodine*, *Oxygen*, *Chlorine*, *Quinine*, *Benzoin*, *Benzoate of Soda*, *Resorcin*, *Salicylic Acid*, *Carbolic Acid*, *and the Antiseptic group*, 366 *et seq.*

LEAD-POISONING :

Sulphuric Acid, 118, forms the insoluble sulphate ; *Magnesium Sulphate*, 751, for the constipation, and for the cachexia a combination of sulphates of quinine and iron, and dilute sulphuric acid. *Sulphides*, 250. *Alum*, 335, is an effective purgative and anodyne in lead-colic ; also alum whey. *Iodides*, 261, and *Bromides*, 652, form soluble combinations and cause excretion of lead. For the paralysis, *Galvanism* and *Faradism*, 465, 466, and *Strychnine*, 486.

LENTIGO:
Glycerite of Iodine, 262, locally. *Tannin*, 346. *Alum*, 337.

LEPRA:
Nitric and Nitro-Muriatic Acid, 119, for the accompanying indigestion. *Arsenic*, 174, long continued, renders important service. *Phosphorus*, 136, and *Phosphates*, 139.

LEUCOCYTHÆMIA:
Oxygen Inhalations, 367, improve the quality of the blood. *Iron*, 151, is of little value in the real, but highly useful in the pseudo-disease. *Chalybeate Springs*, 161, are more useful. *Phosphorus*, 135, and *Arsenic*, 173, are sometimes beneficial. *Digitalis*, 513, in young subjects does good. Also *Strophantus*, 518, and *Adonidin*, 530. *Ergot*, 501, in the splenic form. *Electricity*, 469, as central galvanization, is very beneficial. *Transfusion*, 29. *Red Marrow of Bone*, 436.

LEUCORRHŒA:
Alum, 337, is a cheap and useful injection; may be combined with zinc and borax, in a lotion. *Bismuth*, 164, suspended by mucilage or glycerin, is an excellent injection: may be advantageously combined with *Fluid Extract of Hydrastis*, 191, which is one of the best astringent applications. *Lead*, 315, the acetate of Goulard's extract properly diluted, is an excellent topical application. Zinc, 320. *Iodo-Tannin*, 262, *Tannic Acid*, 345, and *Iodoform and Tannin*, 263, packed about the cervix, is a highly efficient treatment. *Carbolic Acid*, 382, diluted and used with care, is an excellent deodorizer when the discharges are foul; may be combined with the preceding lotions; also *Trichlorphenol*, 386. *Boric Acid* solutions, 420. *Naphtalin*, 415. *Resorcin*, 404. *Monsel's Solution*, 153, is a good application, but stains clothing. *Ichthyol*, 350, and *Alumnol*, 338.

LOCOMOTOR ATAXIA:
Phosphorus, 135, useful to relieve pain and retard changes. *Silver Nitrate*, 302, has done more good than any other remedy, but *Gold and Sodium Chloride*, 297, deserves careful trial. *Hyoscyamine*, 539, especially *Acetanilid*, 426, and *Antipyrin*, 413, relieve the pains. *Electricity*, 467, especially static, the faradic brush, has given great relief.

LUMBAGO:
Acupuncture, 808, and *Baunscheidtismus*, 808, sometimes afford immediate relief. *Aquapuncture*, 809, is also very promptly curative in some cases, and usually relieves. *Chloroform*, 597, also *Ether*, 594, a few drops injected deeply in old cases is remarkably beneficial. *Cimicifuga*, 522, brings about relief, sometimes completely, but often fails. *Galvanism*, 470—descending stabile and labile currents—usually effects a cure. *Iodides*, 261, are curative when disease is due to mercurial, plumbic, or other metallic poisoning. *Morphine*, 641, and with *Atropine*, 644, in minute quantity injected into the muscles affords prompt relief. *Salicylic Acid*, 399, and *Salol*, 410, are appropriate remedies in rheumatismal cases. *Hydrotherapy*, 80, 86, hot douche to back. *Emplastra*, 804, the various anodyne and healing plasters. *Massage*, 102.

LUPUS:
Cod-liver Oil, 126, internally and locally. *Iodine*, 263, and *Iodoform*, 269, in strumous and syphilitic cachexia, and iodoform, etc., to ulcer. *Arsenic*, 174, Fowler's solution long continued exerts a curative influence, and arsenious acid locally. *Zinc Sulphate*, dried, 320, a manageable and efficient caustic. *Carbolic Acid*, 382, undiluted, to sore, and diluted injected beneath. *Corrosive Sublimate*, 294, the first of germicides. *Chromic Acid*, 815, a very powerful caustic, causing but little pain. *Potassa Chlorate*, 225, *Bismuth*, 164, *Bromides*, 657, in powder, dusted over ulcer, have lately been used with great success. *Galvano-caustic*, 474, is an elegant and efficient topical agent; also the method of *Cataphoresis*, 472.

LYMPHOMA OR LYMPHADENOMA:
Arsenic, 176, especially hypodermatically, has good effects. *Phosphorus*, 134, has seemed to cure, but has only benefited. *Iron and Manganese Iodide*, 155; the sirup has improved the general state, and retarded the progress of the disease.

MALARIAL CACHEXIA:
Quinine, 204, is the most important remedy. *Cinchonidine Salicylate*, 206, *Cinchonine* and its salts, 206, and *Chinoidin*, 207, other alkaloids of cinchona, valuable substitutes for quinine. *Benzoates*, 423, *Antipyrin*, 412, *Resorcin*, 404, *Salol*, 409, *Pyridine*, 417, and other antiseptics. *Carbolic Acid*, 380. *Eucalyptus*, 187, is an excellent remedy for the convalescence and for the cachexia. *The Bitters*, 181, are also highly useful under the same conditions. For the anæmia, *Iron*, 148, is invaluable; it acts more efficiently in the cachexia when combined with *Arsenic*, 175, which is also an important remedy in malarial cachexia. *Iron and Manganese Iodide*, 155, is also a valuable restorative. For the changes in the spleen and liver, *Compound Solution of Iodine*, 261, *Ammonium Iodide*, 261, and externally to the splenic region *Ointment of the Red Mercuric Iodide*, 294, are extremely effective.

MANIA, ACUTE:
Anæsthetics, 605, *Paraldehyde*, 585, *Hypnone*, 590, and *Urethan*, 588, are safe and useful remedies; *Chloral*, 617, is more active, but not without danger. *Methylal*, 586 a useful calmative. *Conine*, 665, especially the *Hydrobromate*, without, but especially with, morphine hypodermatically, has

sometimes succeeded in curing acute mania with great motor excitement. In the acute cases with great restlessness, *Gelsemium*, 674, *Duboisine*, 542, and *Hyoscine*, 540, have induced quiet and occasionally effected a cure. *Hyoscyamine*, 538, has become an important remedy as a calmative and hypnotic. *Cocaine*, 562, especially as combined with atropine, when there is great restlessness. *Digitalis*, 512, has proved beneficial in paroxysmal excitement of general paresis, and in acute epileptic mania. *Veratrum Viride*, 720, has acted well under the same circumstances. *Water-Cure*, 86, as warm bath and pack, a valuable calmative.

MANIA, CHRONIC:

Ergot, 501, is highly beneficial in chronic mania with lucid intervals, and in epileptic mania. *Bromides*, 653, are occasionally useful, but not sufficiently active. *Morphine*, 640, is the most important remedy, but *Chloral*, 617, may be better at times. *Iron*, 150, in cases of an anæmic character, may be very useful. *Digitalis*, 512, has good effects in chronic mania, in general paresis, etc. *Physostigma*, 690, has had unexpectedly good results in general paralysis. *Hyoscyamine*, 538, and *Hyoscine*, especially for the trembling and as a hypnotic. To this should be added *Pilocarpine*, 683, which has been very useful in delirium tremens.

MASTITIS:

Belladonna, 533, stops secretion of milk and lessens blood-supply; a solution of atropine brushed over the mamma is the best form. *Phytolacca*, 725, appears to arrest the inflammation; the tincture and fluid extract are convenient for administration. *Pilocarpine*, 683, should be tried in severe cases with much induration.

MELANCHOLIA:

Opium, 640, small and frequent doses of the tincture give best results. *Bromides*, 653, are sometimes highly beneficial, and yet frequently fail. *Cannabis Indica*, 556, is a useful and promising remedy. *Caffeine*, 566, has also done good. *Arsenic*, 173, especially combined with minute doses of opium, and in a greater degree *Aurum*, 297, give excellent results. *Chloral Hydrate*, 617, does good as a hypnotic. *Colchicum*, 354, *Colocynth*, 761, and other agents which unload the portal circulation, render important service.

MENINGITIS. (See CEREBRO-SPINAL MENINGITIS.)

For the acute condition before exudation, or during the stage of excitation, *Opium*, 640, is a remedy of the highest importance; *Chloral*, 617, checks exudation; *Ergot*, 502, *Gelsemium*, 674, *Pulsatilla*, 722, *Aconite*, 715, for their effects on the congestion. For Hyperpyrexia, *Quinine*, 203, *Digitalis*, 512, *Cold Baths*, 87, and the antipyretics, as *Antipyrin*, 412. *Pilocarpine*, 683. During the exudation stage, or stage of depression, *Ammonium Carbonate*, 239, and the *Iodides*, 259.

MENORRHAGIA:

Potassium Bromide, 657, often arrests promptly, and is best adapted to cases of ovarian excitation. *Ergot*, 501, in the menorrhagia of subinvolution. *Oil of Erigeron*, 184, in some cases and in metrorrhagia; also *Canella*, 183. *Cannabis Indica*, 557, sometimes very useful. *Digitalis*, 512, in cases of mitral disease, or when arterial tension is very low. *Ipecacuanha*, 742, is remarkably beneficial in puerperal menorrhagia, and may be advantageously combined with ergot. *Gallic Acid*, 343, sometimes succeeds well. *Aloes*, 758, is indicated in cases dependent on fecal accumulations, in relaxed habits.

MENTAGRA:

Copper Sulphate, 309, *Zinc Sulphate*, 320, and *Silver Nitrate*, 303, lotions, and the germicides, *Resorcin*, 404, *Pyrogallol*, 348, and others.

MERCURIALISMUS:

Iodides, 261, combine with metal and cause its excretion by kidneys, chiefly. *Bromides*, 653, it is asserted, have the same effects. *Belladonna*, 526, is the best remedy for the ptyalism. *Tannin*, 345, *Alum*, 337, *Alumnol*, 338, *Potassa Chlorate*, 216, and the antiseptics, are efficient topical applications. *Quinine*, 200, and the *Mineral Acids*, 114, for the systemic depression. *Hyoscyamine*, 539, is a good remedy for mercurial trembling.

METRITIS:

Water, 88, hot vaginal douche, has good effects. *Carbolic Acid*, 382, undiluted or diluted, applied on cotton-wrapped probe to the lining of the uterine cavity. *Nitric Acid*, 120, the fuming acid, is also applied directly to the cervical canal. *Potassa Fusa*, 225, to the uterine neck to cure indurations. *Ergotin*, 500, persistently used, has great value in chronic interstitial metritis. *Aurum*, 297, chloride, very effective in chronic induration of the uterus. *Silver Nitrate*, pure and in solution, 303, is much employed topically in metritis. *Iodine*, 265, *Iodoform*, 272, and various solutions, are freely used. *Leeches*, 814, to the cervix, give good results. *Saline laxatives*, 750, and *Saline Mineral Waters*, 233, are useful in plethoric subjects.

MIGRAINE:

Ammonium Chloride, 239, a full dose may cut short an attack. *Cannabis Indica*, 556, often succeeds. *Guarana*, 567, *Caffeine*, *Coca*, 561, will usually arrest a seizure. *Ergot*, 500, cures the congestive form, and *Amyl Nitrite*, 706, or *Nitro-glycerin*, 709, the anæmic. *Belladonna*, 529, relieves those cases accompanied by vaso-motor spasm, and *Digitalis*, 512, those with low tension of the vessels and weak heart, or those dependent on a mitral lesion. *Bromides*, 655, if sufficient doses are given, will arrest impending attacks. When reflex from stomach disorder, an emetic of *Ipecac*, 740, will stop; if a symptom of intestinal indigestion, *Sodium Phosphate*, 138. *Antipyrin*, 413, *Acetanilid*, 426, and *Phenacetin*, 418, are efficient analgesics. *Diet*, 65, is of the first consequence in the cases of stomach origin.

MYALGIA:

Ammonium Chloride, 239, sometimes affords relief. The *Salicylates*, 399, *Salol*, 410, and *Acetanilid*, 426, are more efficient. *Electricity*, 468, rarely fails to cure; galvanism and static electricity, and very rapidly interrupted faradic, may alike succeed. Counter-irritation by *Firing*, *Aquapuncture*, 809, and *Acupuncture*, 808, will usually relieve. When a rheumatic condition is the cause, and there is debility from malarial poisoning, *Cinchonidine Salicylate*, 399, will cure; when a mineral poison, the *Iodides*, 261. *Massage*, 102, will usually do good.

MYELITIS:

When idiopathic, *Ergot*, 500, *Barium Chloride*, 242, *Galvanism*, 465, are the most appropriate remedies; when specific, *Mercury*, 288, or the *Iodides*, 261. *Hydrotherapy*, 86, especially the tepid rubbing wet pack. *Massage*, 102, to the damaged muscles. After acute symptoms, or in chronic cases, *Strychnine*, 483, *Picrotoxin*, 491, and similar excitants are proper.

NÆVI:

Chromic Acid, 815, readily destroys with little pain. *Galvano-causty*, 471, is a good means of removing them. *Nitric Acid*, 119, is also an efficient caustic. *Collodion*, 818, by mechanical compression in drying, will sometimes cure.

NARCOSIS. (See ANTIDOTES.)

Ammonia, 238, by inhalation, especially by intravenous injection, in failure of the heart's action. *Oxygen inhalations*, 367, in chloroform narcosis. *Faradism*, 467, to stimulate the respiratory center by reflex irritation, and the respiratory muscles directly. *Amyl Nitrite*, 706, by inhalation in cardiac failure. *Water*, 86, the cold douche and cold affusion in cerebral narcosis, prussic-acid poisoning, sunstroke, etc. *Ether injections*, 594. *Heat*, 93, in alternation with cold. Emetics, *Apomorphine*, 736, *Copper Sulphate*, 308, *Zinc Sulphate*, 318, etc.

NEURALGIA:

Aconite, 715, when there is febrile excitement; *Aconitine*, 715, is particularly effective in neuralgia of the fifth nerve. *Alcohol*, 576, in sufficient quantity, is an anodyne, but the alcoholic habit is quickly formed. *Anæsthetics*, 605, promptly relieve. *Cod-liver Oil*, 126, is of great value as a nutrient. *Chloroform*, by deep injection, 597, is very
effective in ol
619, is useful
following an
561, and with
algin, 427, *Pa*
Urethan, 588,
590, *Acetanil*
for the relief
pains of loco
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etc. *Heat*, 93
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NYMPHOMANIA:

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requisite. *C*
Monobromat
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OBESITY:

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Alkalies, 217,
229. *Ammon*
Permangana
pepsia. The
of Uranium,
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ONYCHIA:

Chloral, 618, an
Thymol, 429,
doform, 263,
Nitrate, 315,
as ointment
remedies.

OPHTHALMIA:

Mercury, 294.
junctiva. *T*
the membra

rose-water. *Atropine*, 530. *Eserine*, 690, to diminish intra-ocular tension. *Pilocarpus*, 683. *Conium*, 665, the alkaloid conine or the succus in blepharospasm. *Silver Nitrate*, 305, *Zinc Sulphate*, 320, and other mineral astringents. *Jequirety*, 811, in granular lids by substitutive inflammation.

ORCHITIS:
Ice, 88, in a bag kept applied. *Iodine*, 262, *tincture*, locally. *Mercury Oleate*, 294, painted over. *Silver Nitrate*, 304, in nitric ether, painted over. *Ammonium Chloride*, 240, in solution with alcohol.

OTORRHŒA:
Lead, 315, lotions of. *Silver Nitrate*, 305, in solution. *Tannin*, 345, the glycerite, locally. *Zinc Sulphate*, 320. *Mercury*, 294, the brown citrine ointment. *Cadmium*, 326, in solution in water. *Sulphocarbolates*, 385. *Airol*, 278, and *Dermatol*, 164, effective topical remedies.

OVARIAN CYSTS:
Iodine Injections, 264, of tincture or compound solution, but adapted only to unilocular cysts. *Electrolysis*, 471, also only in single cysts.

OXALURIA:
Nitro-Muriatic Acid, 119, has special utility. *Nitric Acid*, 115, before meals in acid indigestion and excess of uric acid.

OZÆNA:
Bromine, 371, inhalations of vapor very cautiously. *Carbolic Acid*, 382, solution injected, spray inhaled. *Carbolic Acid and Iodine*, 382, iodine and carbolic acid vaporized and inhaled. *Ethyl Iodide*, 267, by inhalation. *Iodoform*, 262, vaporized or solution in ether applied. *Iodine*, 262, inhaled. *Nosophen*, 276, *Europhen*, 276, and *Aristol*, 277, substitutes for iodoform, and having similar properties; also *Loretin*, 275. *Potassa Bichromate*, 225, solution injected. Iodoform, iodo-tannin, bismuth, zinc oxide, resorcin, thymol, and similar agents applied by *Insufflation*, 6.

PAIN. (See NEURALGIA.)
Opium, 641, in any form, but especially morphine subcutaneously, best of all agents for the relief of pain. *Belladonna*, 532, especially atropine, alone or in combination with morphine. *Anæsthetics*, 605, give immediate relief. *Aconite*, 715, and its alkaloid, aconitine, relieve pain, especially of fifth nerve. *Cannabis Indica*, 556, has slight anodyne properties. *Chloral*, 618, does not relieve pain directly, but by stopping spasm, unless in dangerous narcotic doses. *Croton Chloral*, 619, induces anæsthesia of fifth nerve. *Gelsemium*, 675, has feeble anodyne properties; *Cimicifuga*, 522, even less. *Galvanism*, 468, has decided power to relieve pain. In nocturnal pain, *Iodides*, 259, have remarkable effects. The various analgesic antiseptics, from *Antipyrin*, are effective remedies for pain, 366 *et seq.* *Aquapuncture*, 809, *Acupuncture*, 808, *Blisters*, 807, and *Heat* and *Cold*, 93, relieve pain in varying degree. *Infiltration Anæsthesia*, 24.

PARALYSIS:
Cod-liver Oil, 126, favors the restoration of damaged nerve-elements. *Phosphorus*, 135, with or without oil, as a restorative of nerve-matter. *Strychnine*, 483, an important stimulant, but must be used after local troubles in the nerve-centers have subsided. *Picrotoxin*, 491, employed under similar conditions to strychnine. *Galvanism* and *Faradism*, 466, are first in importance as remedies in the diagnosis and treatment of paralysis; especially adapted to the "myopathies of spinal origin." *Massage*, 102, an important adjunct to other treatment. *Hyoscyamine*, 539, is very useful in paralysis agitans. *Eserine*, 691, is of great service in paralysis of the third nerve. In the paralysis due to gummata, *Iodides*, 259, effect surprising cures. *Ergot*, 501, in vesical paralysis the result of overdistention. *Metallotherapy*, 331.

PARASITES:
Acetic Acid, 244, in pityriasis versicolor and other parasitic skin diseases. *Sulphurous Acid*, 246, destroys sarcina and itch-insect; also *Sulphides*, 249. *Mercury*, 293, the corrosive chloride, is very effective in the various parasitic skin affections. *Salicylic Acid*, 395, *Carbolic Acid*, 382, *Resorcin*, 404, *Pyoktanin*, 414, *Pyridine*, 417, *Naphtalin*, 416, and other antiseptics. *Boric Acid*, 419, *Benzoates*, 422, are useful in same group of affections. *Glycerin*, 817, destroys trichina. *Anthelmintics*, 771, contain the most effective parasiticides of the intestinal canal.

PEMPHIGUS:
Arsenic, 174, cures the chronic form. *Belladonna*, 531, for the acute stage.

PERITONITIS:
Aconite, 714, for the febrile movement. *Chloral*, 616, for restlessness and delirium, and to depress the temperature. *Opium*, 637, is the remedy of highest importance, is best administered as morphine hypodermatically. *Turpentine*, 780, in puerperal peritonitis, with depression and tympanites. *Quinine*, 208, in full doses, with or without morphine, is of great value before the exudative stage. *Ammonia*, 237, *Potash Salts*, 219, during exudation. For external treatment: *Rubefacients*, 803, *Ice-bag*, 88, to abdomen; also *Heat*, 88, and *Poultices*, 822. *Leeches*, 814.

PERNICIOUS FEVER:
Amyl Nitrite, 706, by inhalation to prevent rigor. *Pilocarpus*, 683, *Quinine*, 208, in large quantity by the stomach or hypodermatically. *Morphine*, 639, also, if not contraindicated. *Chloroform*, 597, in time to prevent the depression of the cold stage.

PERSPIRATIONS:
Aromatic Sulphuric Acid, 118, is an ancient

remedy of value. *Atropine*, 531, is one of the most useful remedies for "night sweats," and locally applied for sweats in various local situations. *Picrotoxin*, 491, a minute dose will stop for several nights the sweats of consumption. *Muscarine* and *Agaric Acid*, 729, are also serviceable remedies. For sweating of the feet, *Salicylic Acid*, 399, in powder, dusted over the feet and stockings, is probably the best remedy ; may also be used in lotion with borax ; *Nosophen*, 276, *Aristol*, 277, still more effective applied in the same way. *Potassa Permanganate*, 159, is an elegant toilet deodorant in fetid sweating of axillæ and feet. *Zinc Oxide*, 318, with extract of belladonna in pill, is an ordinary remedy for night sweats ; also *Gallic Acid*, 344.

PHAGEDÆNA :

Bromine, 372, pure, applied with a glass rod, is a good escharotic, but not easily managed, owing to its volatility. *Carbolic Acid*, 382, superficial in its effects, but very useful in mild cases. *Potassa Chlorate*, 225, in powder, a manageable and efficient remedy. *Salicylic Acid*, 399, in powder, to the sloughing and normal tissue adjacent. *Resorcin*, 404, in powder, applied in the same way, and *Boric Acid*, 420, accomplish good results by changing the character of the local action. *Zinc Chloride*, 320, and *Nitric Acid*, 199, are powerfully destructive. *Iodoform*, 271. Internally : *Iodide of Iron*, 150, *Quinine*, 201, *Phosphates*, 140, and the tonics and restoratives in general.

PHARYNGITIS, FOLLICULAR :

In the acute inflammation : *Aconite and Belladonna*, 527. For local application—*Tannin*, 345, *Tannin and Iodoform*, 265, *Iodoform*, 271, in powder or ethereal solution, *Alum*, 337, *Cubebs*, 786, in powder—the powders by insufflation. *Silver Nitrate*, 303, in solution, painted over the surface. *Hydrastis*, 191, the fluid extract, an excellent topical application to mucous membrane inflamed.

PHLEGMON :

Carbolic Acid, 382, a solution injected as an antiseptic. *Iodine*, 263, the tincture or compound solution injected after removal of the pus to prevent decomposition. *Silver Nitrate*, 303, 305, a solution in nitrous ether painted over the inflamed area, may abort the abscess. *Sulphides*, 249, promote formation of matter, or extrusion and healing.

PHOSPHORUS POISONING :

Copper Sulphate, 130, forms insoluble phosphide, and induces active emesis. *Turpentine*, 130, the acid or French. *Transfusion*, 130, to replace damaged blood-corpuscles, has saved life. *Permanganate Potassium*, 157, has proved to be an efficient antagonist, if given in time.

PHTHISIS :

Alcohol, 575, an important remedy when
promotes appetite and digestion, and i
creases the body-weight. *Aliment*, 39, 5
fresh blood, fats, and nitrogenous food
Oxygen, 367, *Hydrogen Dioxide*, 368, *Ga*
Injections, 372. *Pyridine*, 417, *Ethyl Iodid*
267, *Sulphurous Acid*, 247, and other reme
dies used by inhalation. *Calcium Chlorid*
223, has had remarkably good effects in som
cases. *Cod-liver Oil*, 125, is both a valuabl
food and a remedy ; ether aids its digestio
by increasing the pancreatic juice, an
quiets the stomach. *Mineral Acids*, 118
especially nitro-muriatic in large doses
greatly improve the condition of som
cases and retard the progress of the dis
ease. *Carbolic Acid*, 382, has been use
with great advantage by inhalation to de
stroy the fetor of the expectoration, an
to act on the local morbid process ; sys
temically, the acid helps digestion an
stimulates the assimilation. *Creosote*, 387
has been used with remarkable success re
cently. *Phosphates* and *Hypophosphites*
140, *Coca*, 561, with or without cod-liver oil
have good effects in the more chroni
cases. *Arsenic*, 174, improves digestio
and the formation of tissue, and increase
the respiratory capacity. *Strychnine*, 485
checks the vomiting, and is a valuabl
respiratory stimulant. For the nigh
sweats, *Picrotoxin*, 491, *Atropine*, 581, an
sometimes *Pilocarpine*, 683. For the cough
Prunus Virginiana, 183. *Eucalyptus*, 186
for bronchial catarrh.

PITYRIASIS :

Acetic Acid, 244, will destroy the parasit
and cure. *Borax*, 224, is a good application in pityriasis of the scalp. *Corrosiv*
Mercuric Chloride, 293, in solution, i
strong enough, is a certain cure for pityriasis versicolor. *Oleate of Mercury*, 294, ma
also succeed. *Carbolic Acid*, 382, an
Myrtol, 430, will destroy the parasite o
pityriasis versicolor. The *Sulphides*, 250
sulphide of potassa in lime-water is a
excellent application.

PLEURITIS :

Aconite, 714, is a valuable remedy for th
febrile stage. *Bloodletting*, 814, by cup
or leeches, is a good expedient in the initia
stage in plethoric subjects. *Blisters*, 806
are useful at two periods : at the onset an
as resolution begins. *Digitalis*, 511, is a
antiphlogistic, adapted to the pre-exuda
tive stage. *Potassium Iodide*, 259, is use
ful to promote absorption of the exuda
tion, and tincture of iodine and compoun
solution injected to prevent reaccumulation of fluid. *Quinine*, 201, reduces tem
perature and checks exudation. *Morphine*
638, is the most important remedy until ex
udations occur ; quinine and morphine i
sufficient quantity at the outset ma
abort. *Chloral*, 616, is extremely usefu

when there are restlessness and delirium. *Pilocarpus*, 683, causes absorption of exudation.

PNEUMONIA:

Aconite, 714, *Veratrum Viride*, 719, and *Digitalis*, 511, very valuable antipyretics and antiphlogistics for the stage of congestion. *Ammonium Carbonate*, 239, *Ammonium Iodide*, 258, for the liquefaction of the exudation. *Turpentine*, 780, a valuable stimulant when circulation is feeble, and in gangrene. The *subcutaneous injections of ether*, 594, in adynamic condition remarkably effective. *Quinine*, 201, an important remedy under two conditions: in large doses during congestion, and in small tonic doses as a stimulant when depression comes on. *Wet Pack*, 86, and the cold bath, the latter as a remedy for the inflammation, according to Jürgensen, the best. *Serpentaria*, 183, stimulant expectorant. *Muscarine*, 729, is a highly promising remedy. *Morphine*, hypodermatically, 638. *Blisters*, 807, useful at onset, and to promote resolution. *Copper Sulphate*, 309.

POLYURIA:

Dry Diet, 54, of great value. *Gold and Sodium Chloride*, 297, persistently used, an important remedy. *Opium*, 642, large doses are necessary, and therefore extreme danger of forming a habit. *Ergot*, 502, the most beneficial remedy thus far known, probably. *Pilocarpus*, 683, has been used with success.

PORRIGO:

Manganese, 150, an ointment of the oxide. *Oleate of Mercury*, 294, has succeeded. *Lead Iodide Ointment*, 315, in chronic cases.

PROSTATE, HYPERTROPHY OF:

Alkalies, 218, in acid urine, and *Ammonium Benzoate*, 422, for alkaline urine. *Tincture of Iodine*, 264, injected though the walls of the rectum. *Iodoform*, 260, by suppository in the rectum. *Sulphides*, 249, are supposed to induce absorption, *Injections of Ergotin*, or *Ergot*, internally, 502, the most certain means of reducing the size of the organ.

PROSTORRHŒA:

The Urino-Genital Remedies, 776 *et seq.*, notably *Cantharis*, *Turpentine*, *Cubeb*, and *Copaiba*. *Hydrastis*, 190, fluid extract, internally and applied locally. *Tincture of Chloride of Iron*, 152, when there is much debility. *Potassium Bromide*, 657, when there are irritability and excitement. *Ergot*, 502, when relaxation exists.

PRURIGO:

Carbolic Acid, 382, locally and also internally. *Alkaline Warm Baths*, 224, at bed-hour. *Belladonna*, 531, internally, sometimes relieves remarkably. *Prussic Acid*, *Potassium Cyanide*, 702 and 703, in solution, is effective, but must be used with caution. *Pilocarpus*, 642, does good when skin is dry and harsh. *Galvanism*, 470, has special value in cases of neurotic origin. *Sulphides*, 250, afford relief in bath or as an ointment.

PRURITUS VULVÆ:

Borax, 225, a saturated solution freely applied; also *Potassium Bicarbonate*, 225, in solution. *Corrosive Mercuric Chloride*, 294, in solution of sufficient strength. *Oleate of Mercury*, 294, *Cyanide of Potassium*, 703, as an ointment or in solution, if strong enough, relieves greatly, but must be used cautiously; also *Hydrocyanic Acid*, 702, diluted, which may be prescribed in lotion, with borax. *Silver Nitrate*, 303, a solution painted on the affected parts, gives great relief. *Sulphites*, 248, also as a lotion. *Oleates of Mercury* and *Morphine*, 294.

PSORIASIS:

Cod-liver Oil, 126, of the greatest value both internally and locally in cases of strumous origin. *Arsenic*, 174, in chronic cases; may increase the disease at first, but persistently used may effect a cure. *Phosphorus*, 136, acts similarly to arsenic, and may accomplish better results. Locally—*Silver Nitrate*, 303, *Lead*—ointment of the iodide, 315, *Coptis*, 183, especially in psoriasis of the tongue, *Sulphur Baths*, 253, and the *Sulphides*, 249, 250.

PTYALISM:

Belladonna, 526, also *Hyoscyamine* and *Duboisine*, of same group, very effective in mercurial, and ptyalism of pregnancy. In some rare examples, *Pilocarpine*, 642, effective. Locally—*Tannin*, 345, and the *Vegetable Astringents*, 340 *et seq.*

PUERPERAL CONVULSIONS:

Anæsthetics, 605, especially chloroform; the relief is temporary, but time is gained for other measures. *Chloral*, 617, in considerable doses is useful. *Morphine*, 640, hypodermatically, is the most valuable agent in the uræmic form, but full doses are necessary. *Amyl Nitrite*, 705, by inhalation, may do good in cases characterized by high tension of the vessels. *Veratrum Viride*, 720, has proved to be a successful remedy—"invaluable." *Bloodletting*, 814, is necessary when there is cerebral congestion. *Bromides*, 654.

PUERPERAL FEVER:

Quinine, 201, in large doses, first in importance. *Opium*, 640, when there are wakefulness and delirium, especially when local peritonitis exists. *Salicylic Acid*, 396, and the *Salicylates*, *Resorcin*, 404, and *Carbolic Acid*, 380; also, of the same class, *Salol*, 409, *Antipyrin*, 412, *Acetanilid*, 426, and all effective antipyretics, are remedies of great value. *Turpentine*, 779, when there is much tympanites or depression. *Potassa Permanganate*, 157, has been used with success internally.

Puerperal Mania:

Anæsthetics, 605, may be necessary in violent cases. *Bromides*, 653, will quiet, in cases with tendency to cerebral congestion. *Chloral*, 617, is a highly serviceable hypnotic, but its persistent use in anæmic cases is harmful. *Duboisine*, 542, *Hyoscyamine*, 538, and *Hyoscine*, 540, are probably the best *hypnotics* when there are much excitement and restlessness, as well as wakefulness, and the most successful when there is much motor excitement. *Chalybeates*, 150, and *Quinine*, 207, are necessary when there is debility. *Morphine*, 641, under some circumstances is the best hypnotic.

Puerperal Peritonitis:

Opium, 640, is the most important remedy, and is probably curative. *Quinine*, 205, in considerable doses, is next in value; a combination of quinine and morphine. *Turpentine*, 779, is indicated in a condition of systemic depression and when tympanites is present. *Ice*, 84, *Heat*, 88, to the walls of the abdomen.

Purpura:

Digitalis, 509, to overcome the low tension. *Ergot*, 500, slows the heart and raises the tension, and thus checks transudations. *Sulphuric Acid*, 117, *Gallic Acid*, 344, *Lead Acetate*, 314, are astringents of more or less value. *Turpentine*, 779, is of great value usually. *Iron*, 151, is usually indispensable, especially the tincture of the chloride; also *Hœmol*, 54. *Ferratin*, 53. *Oil of Erigeron*, 184, is useful.

Pyæmia:

Quinine, 201, in large doses. *Salicylic Acid*, 396, *Resorcin*, 404, *Salol*, 409, *Antipyrin*, 412, and the *Antiseptics* in general, are useful in varying degree. *Alcohol*, 582, and the *Malt Liquors*, 584, have an important place.

Pyelonephritis:

Eucalyptus, 187, and the *Urino-genital Remedies*, especially *Cantharis*, 799, *Turpentine*, 781, *Pipsissewa*, 790, *Erigeron*, 790, *Gallic Acid*, 344, and the *Antiseptic* group, 392 *et seq.*

Remittent Fever:

Quinine, 202, curative in efficient doses. *Resorcin*, 404, *Salicylic Acid*, 396, *Antipyrin*, 412, *Acetanilid*, 426, and *Benzoates*, 422, come next.

Rheumatic Arthritis:

Lithium, 224, and its salts. *Iodides*, 261, when the disease is due to syphilitic, mercurial, or plumbic poisoning. *Colchicum*, 353, when the gouty or rheumatic diathesis underlies the disease. *Cod-liver Oil*, 125, internally and locally, is adapted to all forms, and one of the best of remedies. *Arsenic*, 173, is beneficial in cases of simple character. *Guaiacol*, 388, as a topical application.

Rheumatism, Acute:

Aconite, 715, tincture of the root, for the fever. *Water*, 85, cold baths for the condition of hyperpyrexia. *Arnica*, 677, a remedy for subacute cases, and *Trimethylamine*, 679, which acts similarly. The *Ammonium* and *Lithium Bromides*, 651, have been warmly commended; the latter also useful in muscular attacks. *Salicin*, 389, in full doses, according to Maclagan, the first of remedies; *Salicylic Acid*, and the *Salicylates*, 397, especially of *Cinchonidine*; *Salol*, 409, has of late been much urged, and the *Benzoates*. 432; also *Antipyrine*, 412, and *Acetanilid*, 426, new and effective remedies. *Quinine*, 201, for hyperpyrexia. *Alkalies*, chiefly *Potassium Bicarbonate*, 218, a plan of treatment very useful under appropriate conditions. *Iron*, 149, tincture of the chloride in full doses a valuable remedy in weak subjects. *Blisters*, 807, a succession of, around the affected joints, give relief and shorten the disease. *Mineral Acids*, 118, have been warmly advocated. *Lemon-juice*, 944, an adjunct to more effective remedies, especially to potash salts.

Rheumatism, Chronic:

Alkaline Mineral Waters, 229 *et seq.*, *Sulphurous Mineral Waters*, 253. The *Turkish Bath*, 93. *Cod-liver Oil*, 125, a very important remedy. *Aliment*, 67, *Colchicum*, 353, in the so-called gouty form. *Guaiac*, 357, is sometimes useful. *Stillingia*, 358, *Xanthoxylum*, 363, and *Cimicifuga*, 522, give relief in the muscular form, and are less beneficial when there are joint changes. *Iodides*, 261, produce excellent results in the cases due to metallic poisoning. *Manganese Sulphate*, 157, does good in cases of gouty antecedents. *Lithium and its Salts*, 224, afford the best results in uric-acid diathesis. *Salicylic Acid*, 397, *Cinchonidine Salicylate*, 399, *Salol*, 409, *Antipyrin*, 412, and the other antiseptics.

Rickets:

Aliment, 67, food rich in phosphates, oils, and lime. *Cod-liver Oil*, 125, is a most important agent in the process of regeneration. *Phosphates*, 140, especially the lacto-phosphate of lime, and *Iron*, 148, especially the sirup of the iodide. *Phosphorus*, 134, induces a hypertrophy of bony tissue, and should therefore be carefully tried in this disease; it may be advantageously given in cod-liver oil.

Roseola:

Belladonna, 531, is a suitable remedy when any remedy is needed, and *Inunctions of Oil*, 124, allay the cutaneous irritation.

Rubeola:

Aconite, 715, and *Digitalis*, 511, are important antipyretics and to relieve the catarrhal process. *Ammonium Carbonate*, 239, has the greatest value in the catarrhal pneumonia when a complication. *Quinine*, 203, is highly useful in large doses when catarrhal pneumonia comes on. The antiseptic antipyretics, when temperature is high, *Antipyrin*, 412, *Acetanilid*, 426, and others. For the broncho-pneumonia, *Iodides*, 259, *Ethyl Iodide*, 267, by inhalation, etc. *Oil Inunctions*, 124, allay irritation of the skin and lessen the febrile heat.

SCABIES:

Sulphur-Baths, 253, *Sulphites* and *Sulphides*, 250, freely and faithfully used, are very effective. *Carbolic Acid*, 382, locally destroys the parasite, but has caused fatal poisoning, too freely used; also *Thymol*, 429, *Corrosive Mercuric Chloride*, 294, if strong enough is very effective, but caution is necessary. *Manganese*, 159, an ointment of the oxide, and solution of *Potass. Permanganate*, 159. *Copper Sulphate*, 309, a lotion of, may be used successfully.

SCARLET FEVER:

Aconite, 715, for the fever and local inflammations. *Digitalis*, 511, a very important remedy as antipyretic and diuretic. *Belladonna*, 528, when the eruption is imperfect or bluish, the peripheral circulation feeble, and the heart's action depressed. *Oil Inunctions*, 124, diminish irritation of the skin and lessen temperature. *Salicylic Acid*, 396, *Sodium Benzoate*, 423, *Resorcin*, 404, *Carbolic Acid*, 380, *Antipyrin*, and the other antiseptics and antipyretics; spray to the throat, and internally for septic infection. *Ammonium Carbonate*, 239, of great value as a remedy and as a stimulant to the depressed circulation. *Quinine*, 203, employed under two conditions—as antipyretic and tonic. *Water*, 85, cold baths and pack, for hyperpyrexia and to develop the eruption in the fulminant cases. *Aqua Chlori*, 369, is a useful gargle and deodorant mouth-wash. *Hydrochloric Acid*, 117, internally, and diluted as a lotion for mouth and throat.

SCIATICA:

Atropine, 532, injected subcutaneously in the neighborhood of the nerve, but the physiological effects must be fully induced. *Cocaine* and *Atropine*, 561. *Methylal*, 586, a twenty-per-cent mixture with oil, rubbed in along the nerve, is said to be very effective. *Morphine*, 641, subcutaneously with or without atropine, has curative effects. *Galvanism*, 468, next to morphine, is the best method of cure. *Aquapuncture*, 809, gives great relief in recent cases. *Acupuncture*, 808, also *Firing*, 808, sometimes relieves. *Chloroform*, 597, and *Ether*, 594, by deep injection in old cases are surprisingly effective. *Silver Nitrate*, 306, in solution, injected near to the nerve-trunk, is curative in some old cases resisting other means. *Salicylic Acid*, 396, *Salol*, *Antipyrin*, 412, and *Acetanilid*, 426. *Iodides*, 261, should be used in cases of syphilitic, plumbic, or mercurial cachexia. *Turpentine*, 781, has occasionally succeeded; also *Guaiac*, 357.

SCLERODERMA:

Cod-liver Oil, 124, the most important remedy. *Phosphates* and *Hypophosphites*, 139, with or without cod-liver oil. *Phosphorus*, 136, in cod-liver oil. *Galvanism*, 470, central galvanization.

SCLEROSIS, SPINAL:

Silver Nitrate, 303, very beneficial. *Phosphorus*, 135, *Galvanism*, 468, and *Static Electricity*, 474, *Electric Brush*, 473, *Iodides*, 261, when there are specific lesions, and in mineral poisoning. *Baths*, 87, the rubbing wet pack. *Massage*, 102. *Oils*, 126.

SCLEROSIS OF THE VESSELS:

Iodides, 258, among the first of remedies. *Phosphates*, 140.

SCROFULA:

Cod-liver Oil, 126, and *Inunctions of Oil*, 124. *Phosphates*, 139, to improve the nutrition. *Iron*, 149, and *Chalybeate Waters*, 161. *Iodides*, 261, of iron and manganese, especially *Iodoform*, 272, *Stillingia*, 358, *Sanguinaria*, 361, and *Sarsaparilla*, 356, promote the activity of the vegetative functions and improve nutrition.

SEA-SICKNESS:

Atropine, 526, subcutaneously, in minute quantity. *Chloroform*, 596, a few drops by the stomach, frequently. *Chloral*, 616, especially useful when there are fever and insomnia, probably the most effective remedy, but must be given before decided nausea sets in. *Sodium Bromide*, 651 [ʒss.—ʒj], begun before embarking, the first of remedies. *Champagne*, 581, iced in small quantity, or effervescent mixtures. *Morphine*, 635, minute doses subcutaneously. *Amyl Nitrite*, 705, by inhalation, and *Nitro-glycerin*, 709, by the stomach, are very useful. Bitters, as *Calumba*, 180, and *Tincture of Nux Vomica*, 482, also sometimes succeed.

SEBORRHŒA:

Zinc Oxide, 320, ointment. *Potassæ Liquor*, 217, 225, locally and internally. *Glycerin*, 817, persistently continued by the stomach.

SEPTICÆMIA:

Quinine, 201, in large doses, as an antipyretic and antiseptic. *Salicylic Acid*, 396, *Resorcin*, 404, and *Benzoates*, 422, are employed for the same purposes: to keep down the temperature and to destroy septic materials. *Bromine*, 371, *Carbolic Acid*, 382, and *Chlorine*, 371, *Boric Acid*, 420, the *Antiseptic Oils*, 428, *Potassa Permanganate*, 157, are all used locally to destroy sloughing and gangrenous parts, to deodorize, and to change the character of the surface. *Cold Baths*, 85, for hyperpyrexia, and *Hot Water*, 89, for wounds.

SKIN-DISEASES:

Oils and Fats, 126, by inunction and locally. *Arsenic*, 174, in chronic, scaly skin-diseases. *Phosphorus*, 134, in place of arsenic and under the same conditions. *Io-*

PUERPERAL MANIA:

Anæsthetics, 605, may be necessary in violent cases. *Bromides*, 653, will quiet, in cases with tendency to cerebral congestion. *Chloral*, 617, is a highly serviceable hypnotic, but its persistent use in anæmic cases is harmful. *Duboisine*, 542, *Hyoscyamine*, 538, and *Hyoscine*, 540, are probably the best *hypnotics* when there are much excitement and restlessness, as well as wakefulness, and the most successful when there is much motor excitement. *Chalybeates*, 150, and *Quinine*, 207, are necessary when there is debility. *Morphine*, 641, under some circumstances is the best hypnotic.

PUERPERAL PERITONITIS:

Opium, 640, is the most important remedy, and is probably curative. *Quinine*, 205, in considerable doses, is next in value; a combination of quinine and morphine. *Turpentine*, 779, is indicated in a condition of systemic depression and when tympanites is present. *Ice*, 84, *Heat*, 88, to the walls of the abdomen.

PURPURA:

Digitalis, 509, to overcome the low tension. *Ergot*, 500, slows the heart and raises the tension, and thus checks transudations. *Sulphuric Acid*, 117, *Gallic Acid*, 344, *Lead Acetate*, 314, are astringents of more or less value. *Turpentine*, 779, is of great value usually. *Iron*, 151, is usually indispensable, especially the tincture of the chloride; also *Hæmol*, 54. *Ferratin*, 53. *Oil of Erigeron*, 184, is useful.

PYÆMIA:

Quinine, 201, in large doses. *Salicylic Acid*, 396, *Resorcin*, 404, *Salol*, 409, *Antipyrin*, 412, and the *Antiseptics* in general, are useful in varying degree. *Alcohol*, 582, and the *Malt Liquors*, 584, have an important place.

PYELONEPHRITIS:

Eucalyptus, 187, and the *Urino-genital Remedies*, especially *Cantharis*, 790, *Turpentine*, 781, *Pipsissewa*, 790, *Erigeron*, 790, *Gallic Acid*, 344, and the *Antiseptic* group, 392 *et seq.*

REMITTENT FEVER:

Quinine, 202, curative in efficient doses. *Resorcin*, 404, *Salicylic Acid*, 396, *Antipyrin*, 412, *Acetanilid*, 426, and *Benzoates*, 422, come next.

RHEUMATIC ARTHRITIS:

Lithium, 224, and its salts. *Iodides*, 261, when the disease is due to syphilitic, mercurial, or plumbic poisoning. *Colchicum*, 353, when the gouty or rheumatic diathesis underlies the disease. *Cod-liver Oil*, 125, internally and locally, is adapted to all forms, and one of the best of remedies. *Arsenic*, 173, is beneficial in cases of simple character. *Guaiacol*, 388, as a topical application.

RHEUMATISM, ACUTE:

Aconite, 715, tincture of the root, for the fever. *Water*, 85, cold baths for the condition of hyperpyrexia. *Arnica*, 677, a remedy for subacute cases, and *Trimethylamine*, 679, which acts similarly. The *Ammonium* and *Lithium Bromides*, 651, have been warmly commended; the latter also useful in muscular attacks. *Salicin*, 389, in full doses, according to Maclagan, the first of remedies; *Salicylic Acid*, and the *Salicylates*, 397, especially of *Cinchonidine*; *Salol*, 409, has of late been much urged, and the *Benzoates*, 432; also *Antipyrine*, 412, and *Acetanilid*, 426, new and effective remedies. *Quinine*, 201, for hyperpyrexia. *Alkalies*, chiefly *Potassium Bicarbonate*, 218, a plan of treatment very useful under appropriate conditions. *Iron*, 149, tincture of the chloride in full doses a valuable remedy in weak subjects. *Blisters*, 807, a succession of, around the affected joints, give relief and shorten the disease. *Mineral Acids*, 118, have been warmly advocated. *Lemon-juice*, 244, an adjunct to more effective remedies, especially to potash salts.

RHEUMATISM, CHRONIC:

Alkaline Mineral Waters, 229 *et seq.*, *Sulphurous Mineral Waters*, 253. The *Turkish Bath*, 93. *Cod-liver Oil*, 125, a very important remedy. *Aliment*, 67, *Colchicum*, 353, in the so-called gouty form. *Guaiac*, 357, is sometimes useful. *Stillingia*, 358, *Xanthoxylum*, 363, and *Cimicifuga*, 522, give relief in the muscular form, and are less beneficial when there are joint changes. *Iodides*, 261, produce excellent results in the cases due to metallic poisoning. *Manganese Sulphate*, 157, does good in cases of gouty antecedents. *Lithium and its Salts*, 224, afford the best results in uric-acid diathesis. *Salicylic Acid*, 397, *Cinchonidine Salicylate*, 399, *Salol*, 409, *Antipyrin*, 412, and the other antiseptics.

RICKETS:

Aliment, 67, food rich in phosphates, oils, and lime. *Cod-liver Oil*, 125, is a most important agent in the process of regeneration. *Phosphates*, 140, especially the lacto-phosphate of lime, and *Iron*, 148, especially the sirup of the iodide. *Phosphorus*, 134, induces a hypertrophy of bony tissue, and should therefore be carefully tried in this disease; it may be advantageously given in cod-liver oil.

ROSEOLA:

Belladonna, 531, is a suitable remedy when any remedy is needed, and *Inunctions of Oil*, 124, allay the cutaneous irritation.

RUBEOLA:

Aconite, 715, and *Digitalis*, 511, are important antipyretics and to relieve the catarrhal process. *Ammonium Carbonate*, 239, has the greatest value in the catarrhal pneumonia when a complication. *Quinine*, 203, is highly useful in large doses when catarrhal pneumonia comes on. The

dides, 262, when syphilitic, mercurial, plumbic, or other metallic poisons underlie the local morbid process. *Mercury*, 290, 294, of great value in secondary syphilitic cutaneous affection. *Quinine*, 208, in ecthyma, erythema nodosum, and when depression of the vital forces exists. *Atropine*, 531, is highly useful in certain cutaneous neuroses, and in simple vascular lesions. *Pilocarpus*, 684, when the skin-secretions are deficient, and in alopecia. *Jequirity*, 811, in the hypertrophic affections. *Sarsaparilla*, 356, has long been celebrated in syphilitic and strumous affections of the skin. *Mineral Acids*, 119, in diseases secondary to stomachal and intestinal indigestion. *Electricity*, 470, in the neuroses of the skin. Locally, the salts of *Zinc*, 320, and *Mercury*, 294, *Tannic Acid*, 346, as glycerite or in powder. *Carbolic Acid*, 382, *Sulphocarbolates*, 385, *Trichlorphenol*, 386, and *Iodine*, 263, are freely used in various acute and chronic affections. *Stains of Silver Nitrate*, 305, are removed by a solution of cyanide of potassium, iodine, and water.

SPERMATORRHŒA :
Atropine, 530, *Ergot*, 501, and *Digitalis*, 513, when the genitals are relaxed, the erections feeble because of deficient filling of veins of erectile tissue, and the ejaculator muscles paretic. *Cimicifuga*, 522, acts similarly, but less strongly. *Nux Vomica*, 483, or strychnine is indicated when a stimulant and tonic are required, and *Cantharis*, 799, under similar circumstances. *Iron*, 152, tincture of the chloride, when anæmia is a marked feature, and *Arsenic*, 175, as a systemic tonic and genital stimulant. *Potassium Bromide*, 657, *Lupuline*, 647, and *Camphor*, 547, when a genital sedative is indicated. Locally, *Hydrastis*, 191, fluid extract, *Tannin*, 346, and vegetable and mineral astringents.

SPINA BIFIDA :
Iodine, 262, the tincture injected into the sac. *Collodion*, 819, in drying, contracts and mechanically compresses.

SPINAL IRRITATION :
Electricity, 466, is an efficient means of allaying the pain and tenderness. *Strychnine*, 483, one of the best tonics for the primary assimilation, and stimulant for the depressed nerve-centers. *Ergot*, 501, is required when active hyperæmia is present. *Potassium Bromide*, 657, does good under the same conditions. *Mitchell's Cure*, 103, by massage, rest, and faradism, sometimes useful, often disappointing.

SPLEEN, DISEASES OF :
Remedies acting on the spleen are, in anæmia, *Iron*, 147, *Manganese*, 156, and *Arsenic*, 171; in vascular dilatation, *Ergot*, 499, *Quinine*, 204, *Belladonna*, 530, *Muscarine*, 729, *Resorcin*, 404. The most efficient external applications are : *Cold Affusion*, 88, which causes contraction of the splenic vessels, *Ointment* of the *Red Mercuric Iodide*, 294, which, if properly applied, causes a rapid reduction of simple hypertrophy, *Ointment of Lead Iodide*, 315.

STERILITY :
Aurum, 297, chloride of gold and sodium, when due to chronic interstitial metritis. *Phosphorus*, 135, when simple functional debility in the male is the condition.

STOMATITIS :
Alcohol, 577, *Brandy and Water*, an excellent astringent wash. *Bismuth*, 164, in powder freely applied. *Acids*, 114, hydrochloric, applied directly to ulcers. *Eucalyptus*, 186, *Hydrastis*, 189, *Krameria*, 343, and other vegetable astringents, the fluid extracts being applied pure or variously diluted to the affected parts. *Potassium Chlorate*, 217, the most valuable application, and especiallysy stemic remedy ; also *Potass. Bromide*, 660.

STRANGURY :
Opium, 635, the tincture by enema, or, better, morphine subcutaneously. *Gelsemium*, 634, *Aconite*, 715, *Veratrum Viride*, 720, and *Bromides*, 657, afford relief in varying degree. For vesical strangury, *Cantharides Tincture*, 799, *Turpentine*, 781, and various urino-genital remedies, and the antiseptics having analgesic properties.

STRICTURE :
Electrolysis, 471, an effective remedy if properly applied.

STRYCHNINE-POISONING :
Emetics or Stomach-Pump ; *Tannin*, *Compound Solution of Iodine*, chemical antidotes, *Chloral*, *Chloroform*, by inhalation, *Nicotine*, subcutaneously, physiological antagonists. *Rest*, *Artificial Respiration*, and *Galvanism*, 469.

SUPPURATION :
Alcohol, 577, a powerful antiseptic and antipyretic, and, externally, a valuable antiseptic dressing. *Carbolic Acid*, 382, and the *Antiseptics* in general. *Quinine*, 208, in full doses, as a tonic. *Sulphites*, 247, and *Sulphides*, 249, small doses frequently mature abscesses, and under some circumstances abort them; also *Sulphurous Mineral Waters*, 253, *Phosphates*, 140, and *Lime Salts*, 223, to repair waste by suppuration. *Iron and Manganese Iodides*, 149, the sirup of, in the systemic depression caused by suppuration.

SWEATING. (Hyperidrosis—see PERSPIRATION.)
Mineral Acids, 118, especially aromatic sulphuric acid. *Aristol*, 277, *Nosophen*, 276, useful applications when dusted on. *Zinc Oxide*, 318, in night-sweats of phthisis, especially with extract of belladonna. *Gallic Acid*, 344, restrains sweating. *Atropine*, 531, is a powerful means of arresting perspiration ; also *Duboisia*, 543, and especially *Picrotoxin*, 491, *Pilocarpus*, 682, *Resorcin*, 404, and *Salicylic Acid*, 403, cause

sweating, and under some conditions arrest it. *Alkalies*, locally, 224.

SYCOSIS:

Carbolic Acid, 382, internally and externally. *Mercury Oleate*, 294.

SYNOVITIS:

Cod-liver Oil, 125, is useful in strumous and debilitated constitutions. *Silver Nitrate*, 304, in nitrous ether, painted over the joint. *Carbolic Acid*, 382, solution injected into the joint. *Mercury and Morphine Oleate*, 294, *Massage*, 102.

SYPHILIS:

Baths, 85, Turkish baths, wet packs, and vapor-baths, are very important in promoting excretion. *Denutrition*, or hunger-cure, 54. *Cod-liver Oil*, 126, useful in chronic cases and broken-down constitutions. *Mercury*, 290, the great remedy for constitutional syphilis—by stomach, by inunction, by fumigation, or subcutaneously. *Iodides*, 260, in constitutional, certain forms of secondary and tertiary disease, are unrivaled in efficacy. *Aurum*, 297, comes into use after iodides and mercury, to which it is greatly inferior. *Iron*, 148, especially the iodide, in sloughing phagedæna and in depressed states of the system at all stages. *Iodoform*, 263, as a local application to chancres. *Carbolic Acid*, 382, *Salicylic Acid*, 400, *Boric Acid*, 420, *Benzoin*, 423, *Potassa Chlorate*, 225, in powder, are valuable local applications to syphilitic sores, abscesses, discharging buboes, phagedæna, etc. *Sarsaparilla*, 356, *Stillingia*, 358, *Guaiacum*, 357, are important adjuncts, vehicles, and remedies for the constitutional disease, the system being unequal to further iodine and mercurial treatment.

TÆNIÆ:

The various *Tæniafuges*, 774 *et seq.*, *Resorcin*, 404, and *Salicylic Acid*, 395, have killed tænia, so that a purgative only was necessary. *Chloroform*, 597, lately much used. *Turpentine*, 779, is one of the most efficient remedies, although unpleasant in the highest degree. *Ailanthus*, 726, has succeeded. *Papāin*, 109, and other digestive ferments.

TETANUS:

Atropine, 532, injected into the rigid muscles, has done good. *Strychnine*, 483, is alleged to be curative in some cases, but more than doubtful. *Chloral*, 618, is certainly a remedy of great value. *Amyl Nitrite*, 706, has been used with success; *Nitro-glycerin*, 709, should also be fairly tried. *Gelsemium*, 674, has succeeded, and is a promising remedy. *Curara*, 670, valuable, but uncertain. *Potassium Bromide*, 653, seems to be the most successful remedy. *Physostigma*, 689, has also been used with advantage in a number of cases, but its real value remains to be determined. *Hyoscyamine*, 539, or *Duboisine*, 542, may be used. *Nicotine*, 654, has effected a cure, but its use requires caution. *Anæsthetics*, 607, give temporary relief. *Morphine*, 641, injected into the tetanized muscles, gives great relief. New remedies that have proved useful are *Paraldehyde*, 585, *Urethan*, 588, and *Hypnone*, 590, especially the first named.

THERMIC FEVER, OR SUNSTROKE:

Cold Baths, 84, for the hyperpyrexia. *Morphine*, 638, subcutaneously, when convulsions occur, or the insensibility and high temperature persist. *Pilocarpine*, 683, should be tried. *Quinine*, 202, *Antipyrin*, 411, *Salol*, 409, *Acetanilid*, 426, and other antipyretics should be administered subcutaneously.

THROMBOSIS AND EMBOLISM:

Ammonia, 238, by the stomach or by intravenous injection, to liquefy the obstructing clot. *Ergot*, 500, *Quinine*, 201, and *Digitalis*, 509, for the collateral hyperæmia and œdema.

TIC-DOULOUREUX. (See NEURALGIA.)

Atropine and *Morphine*, 641, 644; these alkaloids in combination subcutaneously give relief. *Croton-Chloral*, 619, has special effects on the fifth nerve. *Aconitine*, 715, has lately been given with good results. *Galvanism* and *Magnetism* relieve the pain, 468. *Antipyrin*, 411, and *Acetanilid*, 426, for pains of locomotor ataxia and of neuritis. *Cocaine*, 561, and *Cocaine-Atropine*, 563, subcutaneously, are effective anodynes. *Teucrin*, 431, subcutaneously, *Phenacetin*, 418, *Thymol*, 428, *Hypnone*, 590, *Urethan*, 588, and its congeners, are active analgesics.

TINEA:

Boric Acid, 420, is an excellent topical application. *Mercury*, 294, corrosive sublimate, as an ointment or lotion for tinea tonsurans; oleate of mercury in oleic acid, also, 309, of *Copper*, and an ointment of the carbonate. *Carbolic Acid*, 382, applied directly or in glycerin to the part affected. *Sulphites*, 248, in solution, also useful. *Sulphides*, 250, sulphur-baths, 250, faithfully carried on, are curative.

TONSILLITIS:

Aconite, 713, the tincture of the root, in cases accompanied by fever. *Guaiacum*, 357, a full dose is said to abort an attack. *Ice*, 81, held against the inflamed part, diminishes the congestion. *Mercury*, 286, small doses of calomel or gray powder reduce the inflammation. *Quinine*, 200, in a full dose at the outset may abort an attack. *Alum*, 337, in powder, solution, or whey, does good after the acute symptoms. *Tincture of Iodine*, 264, injected, will gradually diminish the hypertrophied tonsil.

TOOTHACHE:

Alum, 337, a solution in nitrous ether is said to be effectual. *Tannin*, 345, dissolved in ether, also relieves the pains of a carious sion. *Oxygen*, [illegible], and *Hydrogen Dioxide*, [illegible].

VOMITING OF PREGNANCY:

Cerium, [illegible], is a good remedy if given in full doses. *Iodine*, [illegible], a drop of the tincture of the compound solution, or of the compound tincture, may succeed when other remedies fail. *Carbolic Acid*, [illegible], may succeed, but is uncertain, and its odor may excite disgust. *Calumba*, [illegible], a few drops of the tincture may quiet the stomach quickly, but it often fails. *Ingluvin*, [illegible], has been frequently successful; also *Pepsin*, [illegible], but is less useful than the former. *Nux Vomica*, [illegible], a drop or two of the tincture may prove beneficial. *Arsenic*, 171, a drop of Fowler's solution sometimes acts most favorably. *Hydrocyanic Acid*, [illegible], often does good and often fails. *Alcohol*, [illegible], as sparkling wine, may succeed temporarily. *Oxygen*, [illegible].

WHOOPING-COUGH:

Atropine, [illegible], is a good remedy when secretion is profuse, and in the spasmodic stage: decided physiological effects should be produced to have any curative action. *Hyoscine*, [illegible]. *Bromides*, [illegible], give relief to the spasmodic condition—to the whoop—but *Bromoform*, [illegible], is more decidedly curative. *Monobromated Camphor*, 512, seems to be quite useful. *Hydrobromic Ether*, [illegible], subcutaneously, by stomach, or by inhalation. The *Urethan* group, [illegible], are safe and effective antispasmodics. *Hypnone*, [illegible], *Methylal*, 585, *Paraldehyde*, [illegible], and *Pyridine*, 417, act similarly. *Bromoform*, [illegible], and its congeners, 661, have special utility. *Chloral*, 617, is very useful at any stage, but is most serviceable during the spasmodic. *Castanea*, 344, a decoction of the leaves may be taken at pleasure, and with certainty of some, although not marked,

benefit. *Nitric Acid*, 118, sometim
fits exceedingly, but is uncertain.
[illegible], especially when there is a
bronchial secretion. *Lobelia*, 656,
acts as a nauseant, is most benefici
bolic Acid, [illegible], by inhalation, seem
very valuable remedy. *Sodium B*
434, internally and by spray, is rep
be very serviceable. To these
added *Salicylates*, *Resorcin*, *An*
Acetanilid, and other antiseptics,
Lactucarium, [illegible], the sirup, is a u
hicle for the exhibition of other m
Asafœtida, 551, a disagreeable b
remedy, may be given freely to inf
young children. *Hydrocyanic A*
may be given during the spasm st
it is most efficacious as a remedy
cough kept up by habit after th
dence of the disease, and the c
imitation.

WORMS. (See PARASITES.)

Eucalyptus, 186. *Calomel*, [illegible], an e
remedy to expel the round worm
best administered with santonin.
Acid, [illegible], has been used succ
against tænia. *Anthelmintics*,
Papain, 109.

WOUNDS:

Lister's Method, 383, 400, 420. *Water*
therapy, 89 *et seq.*, cold and hot, as
ing for wounds, to arrest hæm
and, in form of baths, to depress al
heat. *Alcohol*, 540, an excellent a
and astringent dressing, and as a
in pyrexia.

WRITER'S CRAMP:

Metallotherapy, 331. *Faradism*, 466

YELLOW FEVER:

Carbolic Acid, 381, *Champagne*, ic
Turpentine, [illegible], for the vomiting.

THE END.

official pill may be used; it is successful in the case of pale, strumous, and feeble subjects. *Strychnine*, 483, may succeed when the other remedies fail; must be pushed, and is best adapted to cases characterized by great nerve mobility or weakness. When the urine is *acid*, a proper *Diet*, 61, and *Alkalies*, 221; when *alkaline*, the *Ammonium Benzoate*, 422.

UTERINE COLIC:
Aquapuncture, 809, gives surprising relief. *Morphine* and *Atropine*, 638, 640, subcutaneously. *Camphor*, 548, *Gelsemium*, 675, and the anodynes derivative from alcohol. *Chloral*, 617, *Ether*, 593; also *Paraldehyde*, 585, *Hypnone*, 590, *Urethan*, 588, etc.

UTERUS, FIBROMATA OF:
Ergotin, 501, subcutaneously and by stomach and rectum. *Hydrastinine*, 191, of special value in myomata and hæmorrhage. *Gold and Sodium Chloride*, 297, persistently used. *Calcium Chloride*, 223, also taken for a long time. *Saline and alterative Waters*, 253 *et seq.*; those of St. Catharine's, Canada, of Homburg and Kreutznach, etc. *Iodine* and *Iodoform*, 260, tincture and glycerites, 263, applied topically. *Electrolysis*, 470.

UTERUS, HYPERTROPHY OF; also SUB-INVOLUTION:
Ergot, 501, fluid extract, and *Cornutine*, subcutaneously, must be persistently administered for a long time. *Hydrastinine*, 191, is of value in uterine hæmorrhage and congestion. *Electricity*, 470, galvanism—an interrupted current, of great value in cases of simple enlargement. *Iodoform*, 263, and *Iodo-Tannin*, applied directly to the uterus, promote absorption. *Gold and Sodium Chloride*, 297, long continued in small doses, does much good. *Phytolacca*, 725, *Digitalis*, 509, and *Cimicifuga*, 522, are very useful in sub-involution. *Ipecacuanha*, 742, has remarkably good effects in recent cases of sub-involution, with menorrhagia or metrorrhagia.

UTERUS, ULCERATION OF:
Hydrastis, 190, the fluid extract undiluted, freely applied, is a valuable application in cervicitis, endocervicitis, ulcer, and eversion. *Iodo-Tannin*, 263, iodoform and tannin packed around the cervix, is a highly useful remedy in ulceration and other disorders. *Silver Nitrate*, 304, a long-used and highly esteemed topical remedy, but has been much abused. *Carbolic Acid*, 382, pure, on cotton-wrapped probe, is a safe and efficient application in endocervicitis, endometritis, and ulcerations. *Vegetable Astringents*, 346, oak, heuchera, hamamelis, rubus, etc., in the form of strong decoctions, injections, or fluid extracts, undiluted. *Glycerite of Tannin*, 345, and *Glycerin*, 817, are useful in greater or less degree.

VARICOCELE and VARICOSE VEINS:
Ergot, 504, ergotin injected subcutaneously alongside the enlarged veins, an effective but painful expedient. The injection *must not enter the veins.* Same expedient can be practiced in the case of any varicose veins in an accessible situation.

VARIOLA:
Water, 85, cold baths for fever, especially hyperpyrexia. *Quinine*, 203, small doses as a tonic, full doses for the suppuration, and antipyretic doses if the temperature is high. *Ammonia Carbonate*, 239, if there is manifest depression, and especially during the suppuration stage. *Chloral*, 617, is highly useful and necessary when there are high temperature, wakefulness, and delirium. *Opium*, 638, for wakefulness, low delirium, and adynamia. *Carbolic Acid*, 380, *Resorcin*, 404, *Salicylic Acid*, 396, and *Acetanilid*, 426, are from the theoretical standpoint valuable antiseptics and antipyretics. *Iodine*, 262, tincture, is applied to pustules to prevent pitting. *Silver Nitrate*, 303, a pointed stick of, is inserted into each pustule to abort it and thus prevent the formation of a cicatrix.

VOMITING:
Alcohol, 581, iced champagne or brandy in small quantity frequently, will sometimes arrest vomiting of pregnancy, of sea-sickness, of cholera, yellow fever, etc. *Ether*, 593, *Chloroform*, 597, a few drops frequently, will arrest some kinds of vomiting, as sea-sickness, passage of gall-stones, etc. *Bromides*, 651, are serviceable in cerebral vomiting, and in cholera infantum in children, and in some cases of reflex vomiting. *Chloral*, 616, highly useful in vomiting of sea-sickness, cholera, and reflex vomiting. *Ipecacuanha*, 741, rarely in minute doses, will arrest some nervous and reflex attacks of vomiting. *Arsenic*, 171, drop-doses of Fowler's solution, will stop vomiting of irritative dyspepsia, of ulcer, etc. *Hydrocyanic Acid*, 701, can be prescribed in the vomiting of acute stomach troubles. *Pepsin*, 107, *Milk and Lime-Water*, 223, *Bismuth*, 163, are proper in the vomiting of indigestion, of stomach inflammation, of acidity, and of acute intestinal disorders. *Calomel*, 280, very minute doses of, will stop vomiting in cholera infantum and in other intestinal disorders in children. *Cerium Oxalate*, 328, is one of the numerous remedies for the vomiting of pregnancy. *Amyl Nitrite* and *Nitro-glycerin*, 709, are said to be very effective in the vomiting of sea-sickness. *Alkalies*, 217, especially the effervescent powder. *Nux Vomica*, 482, the tincture, will sometimes succeed in atonic states. *Creosote, Carbolic Acid*, 379, has remarkably sedative effects, and will arrest the vomiting of acute stomachal and intestinal disorders; it is advantageously combined with bismuth in an emul-

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